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Department of Industry, Science, Energy and Resources

Office of the Chief Economist

Resources and Energy Quarterly

December 2021

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Foreword

Australia's resource and energy export earnings are expected to reach a record $379 billion in 2021–22. Although new COVID-19 cases in some nations is inhibiting a full global economic recovery, energy shortages appear set to buoy Australian resource and energy export earnings over the rest of 2021–22. While this year's result represents a significant increase on 2020–21, earnings are expected to ease back to $311 billion in 2022–23, as energy prices fall back.

Chinese power shortages have been a dominant influence on global resource and energy commodity prices since our last report. As a major global metal refiner, the power shortages have seen Chinese (base and ferrous) metal output cut back. China's property sector has slowed noticeably since our last report, cutting metal usage. But, the Chinese authorities now appear to be taking steps to stabilise the sector.

Since the last *Resource and Energy Quarterly* (REQ), there have been a few significant policy developments with the potential to have a noticeable impact on the global resources and energy sector. Some have short term implications, others much longer term. After policy action to bring down iron ore prices in the middle of the year, in October China's government instructed the nation's coal miners to lift output and imposed a thermal coal price cap. The US Congress passed a US$1.2 trillion infrastructure program, which will have a stimulatory effect on US economic growth domestically and have flow-on effects offshore. Finally, the US Geological Survey has proposed adding nickel and zinc to the list of minerals classified as "critical" by the US. With some of the world's largest reserves, Australia is well placed to sell nickel and zinc to the United States.

Australian iron ore earnings are forecast to decline noticeably in the outlook period. The global economic recovery and constrained supply saw prices exceed US$230/tonne in the middle of 2021, but sharp reductions in Chinese steel production contributed to large price declines in the second half of 2021. The ongoing recovery in Brazilian supply is set to impact adversely on prices during the outlook period.

A stronger outlook for base metals and coal have more than offset the impact on export earnings of the downward adjustment we have made to our iron ore price forecasts. Lithium exports — of spodumene concentrate and refined chemicals — are expected to almost match zinc exports in 2022–23, as car makers race to capture the electric vehicle market. Exporters of aluminium, nickel, zinc and copper are also benefiting from the global move to low emission technologies.

Thermal coal prices surged in China in October, as critical shortages emerged in many major consuming nations. Seaborne thermal coal prices rose to their highest level in more than a decade. High demand from major steel producing nations, and problems with Mongolian supply, have seen Australian metallurgical coal prices reach record highs, with monthly export earnings now easily exceeding pre COVID-19 levels.

After a fall of 3.1% in 2020, the IMF forecasts world GDP growth of 5.9% in 2021, 4.9% in 2022 and 3.6% in 2023. The recovery is expected to be dominated by the advanced nations, where the COVID-19 vaccine rollout has been fastest and vaccine access wider. Households in advanced nations have built their savings during the pandemic, but these savings may be drawn down significantly over the outlook period. The rate of growth in the Chinese economy will continue to play an important role in global resource and energy commodity demand. The IMF forecasts China's GDP growth to be 8.0% in 2021, 5.6% in 2022 and 5.3% in 2023.

With energy inventories lower than normal, the severity of the remainder of the Northern Hemisphere winter will have a critical influence on energy markets in the short term. The La Nina weather pattern will likely impact on the demand and supply for coal and other energy products.

The risks to the record export earnings forecast for 2021–22 are skewed to the downside. They include a much faster than expected decline in coal prices. There is also potential for a further rise in global inflation and a risk of higher interest rates in response. Uncertainties associated with new strains of the coronavirus, and the risk of delays in the rollout of COVID-19 vaccines to the world's population, could also pose significant risks.

About this edition

The *Resources and Energy Quarterly* (REQ) contains the Office of the Chief Economist's forecasts for the value, volume and price of Australia's major resources and energy commodity exports.

A 'medium term' (five year) outlook is published in the March quarter edition of the *Resources and Energy Quarterly*. Each June, September and December edition of the *Resources and Energy Quarterly* features a 'short term' (two year) outlook for Australia's major resource and energy commodity exports.

Underpinning the forecasts/projections contained in the *Resources and Energy Quarterly* is the Office of the Chief Economist's outlook for global resource and energy commodity prices, demand and supply. The forecasts/projections for Australia's resource and energy commodity exporters are reconciled with this global context.

The global environment in which Australia's producers compete can change rapidly. Each edition of the *Resources and Energy Quarterly* attempts to factor in these changes, and makes appropriate alterations to the forecasts/projections by estimating the impact on Australian producers and the value of their exports.

In this report, commodities are grouped into two broad categories, referred to as 'resources' and 'energy'. 'Energy' commodities comprise metallurgical and thermal coal, oil, gas and uranium. 'Resource' commodities in this report are all other mineral commodities.

Unless otherwise stated, all Australian and US dollar figures in this report are in nominal terms. Inflation and exchange rate assumptions are provided in tables 2.1 and 2.2 in the *Macroeconomic outlook* chapter.

Information in this edition of the *Resources and Energy Quarterly* is current as of 16 December 2021.

Resources and Energy Quarterly publication schedule

Publication	Expected release date	Outlook period final year
March 2022	4 April 2022	Australian data: 2026–27 World data: 2027
June 2022	4 July 2022	Australian data: 2023–24 World data: 2024
September 2022	4 October 2022	Australian data: 2023–24 World data: 2024
December 2022	19 December 2022	Australian data: 2023–24 World data: 2024

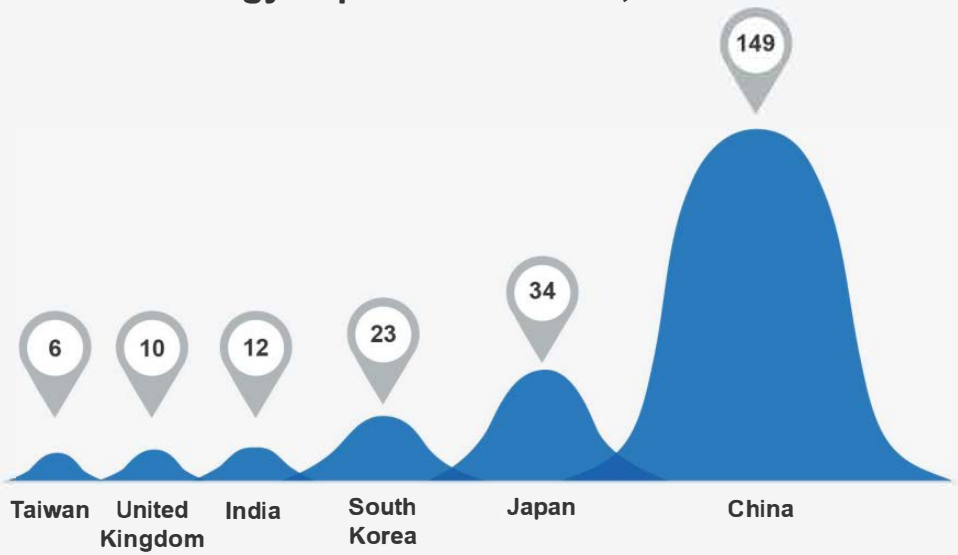
Source: Department of Industry, Science, Energy and Resources (2021)

Overview

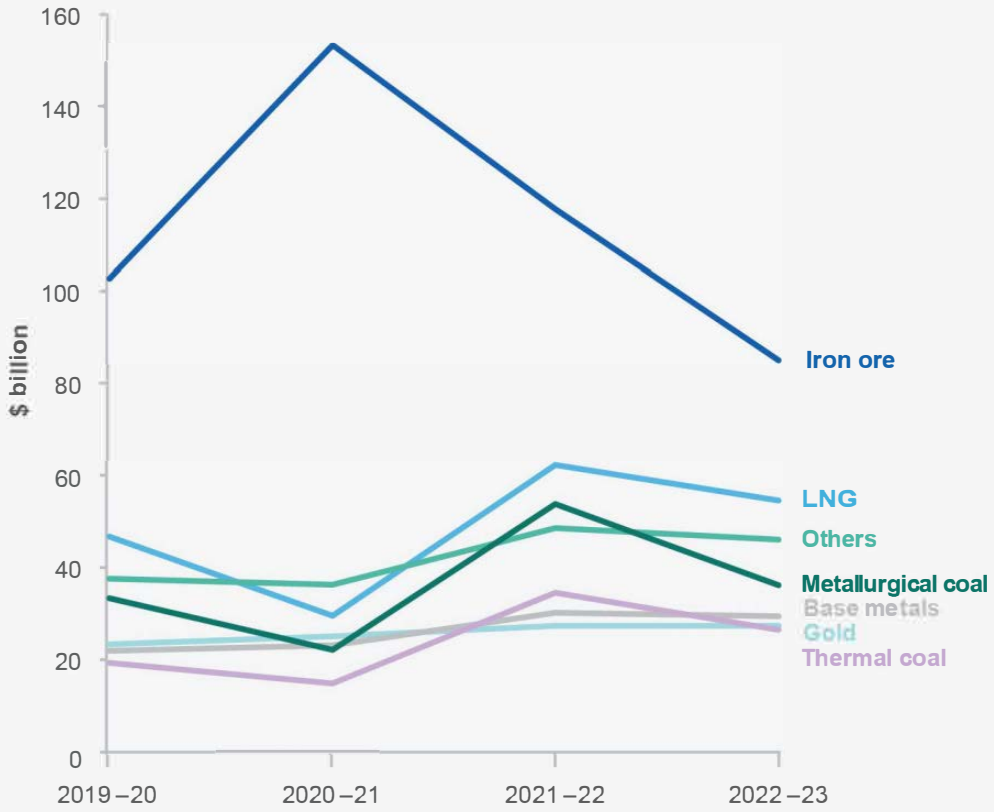
Australia's mining sector

- **Around 10% of GDP**
- Makes up more than **half of Australia's** total exports
- **Directly employs around** a quarter of a million people

Major markets for Australia's resources and energy exports in 2020-21, A$billion



Australia's resources and energy exports



1.1 Summary

- The outlook for Australia's mineral exports remains strong, as the world economy rebounds from the impact of the COVID-19 pandemic and energy shortages persist. High prices, good volume growth and a weak Australian dollar are driving a surge in export earnings. Some decline in prices is likely in 2022, as supply rises and demand growth moderates.
- Export earnings are expected to rise by 22% to a record $379 billion in 2021–22, before declining to $311 billion in 2022–23.
- Iron ore prices have continued to decline, but remain at very profitable levels for most Australian miners. Coal and LNG prices have spiked, driven by ongoing shortages and strong demand.

1.2 Export values

Australia's export values are estimated at about $380 billion in 2021–22

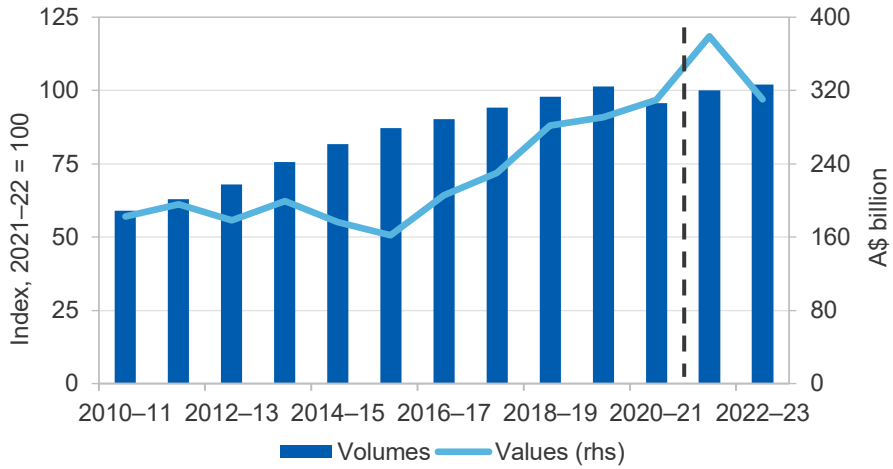
In the December quarter 2021, the Office of the Chief Economist's (OCE) Resources and Energy Export Values Index rose 34% from December quarter 2020; a 1% rise in volumes added to a 33% gain in prices.

Exports are forecast to reach a record $379 billion in 2021–22, up from $310 billion in 2020–21 (Figure 1.1), but then fall back to $311 billion in 2022–23. With volumes growing modestly, price movements are expected to determine much of the change in earnings (Figure 1.2). Commodity prices are set to fall once demand growth slows and global supply rises.

Weaker Australian dollar to help boost earnings

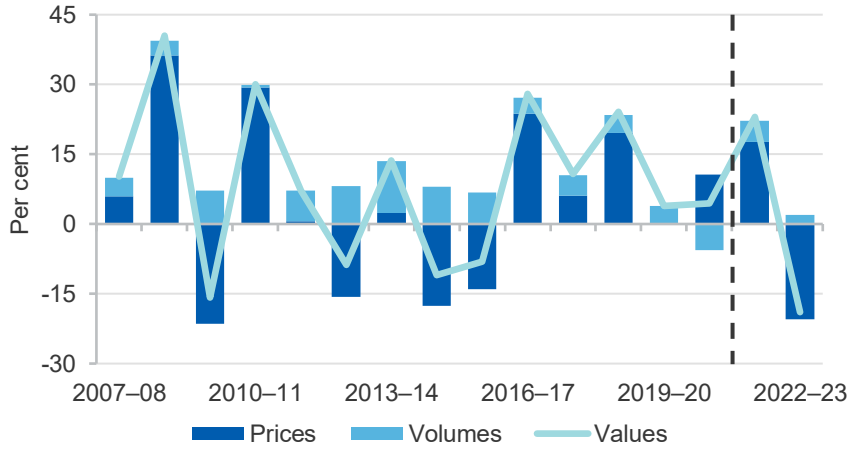
In Australian dollar terms, the OCE's Resources and Energy Commodity Price Index fell by 4% (preliminary estimate) in the December quarter 2021, but was up 33% on a year ago. In US dollar terms, the index fell by 5% in the quarter, but was 32% higher than a year ago. The index of prices for resource commodity exports (Australian dollar terms) fell by an estimated 16% in the year to the December quarter 2021. Energy commodity prices rose by 155% (Figure 1.3) from December quarter 2020 — which was near the COVID-19 crisis lows.

Figure 1.1: Australia's resource and energy export values/volumes



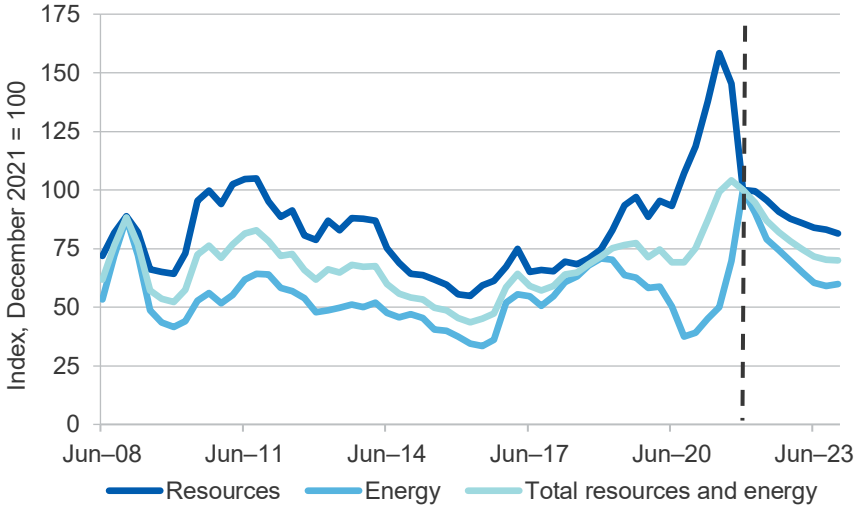
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Figure 1.2: Annual growth in Australia's resources and energy export values, contributions from prices and volumes



Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Figure 1.3: Resource and energy export prices, AUD terms



Notes: The export price index is based on Australian dollar export unit values (EUVs, export values divided by volumes); the export price index is a Fisher price Index, which weights each commodity's EUV by its share of total export values.

Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

1.3 Macroeconomic, policy, trade and other factors

The recovery in world economic activity continues to be hampered by new COVID-19 outbreaks and the fallout from previous outbreaks. Developing nations lag developed nations noticeably in the COVID-19 vaccine rollout, but some of the latter are also encountering problems with infections amongst unvaccinated parts of their populations. New drugs aimed at treating those with COVID-19 may help reduce the impacts from infection. However, fresh significant COVID-19 outbreaks remain a risk.

After mid-year policy action to bring down iron ore prices, in October 2021, the Chinese Government instructed the country's coal miners to increase output and imposed a ceiling on the price of thermal coal. The measures helped to bringing prices down from historical highs, but the weather and the COVID-19 pandemic could easily see the market re-tighten.

The outcome of the COP26 Climate Change summit is unlikely to impact short term thermal coal usage. However, medium/long term supply may be affected as some miners reassess plans for new and expanded capacity.

The outlook is for strong growth in the world economy over 2022 and 2023, as vaccination rates rise. The latest IMF forecasts put world GDP growth at 4.9% in 2022 and 3.6% in 2023, after growth of 5.9% in 2021. The Chinese economy has slowed, as a result of problems amongst some highly leveraged property developers. However, there are signs that the government is acting to stabilise property markets; the People's Bank of China cut the bank required reserve ratio in early December, and state-owned developers are buying landing and building projects. Chinese industrial activity is likely to pick up after the Beijing Winter Olympics end. The Chinese government and the central bank continue to vary different policy instruments to try to limit significant fluctuations in economic growth.

Japan's government passed a large fiscal stimulus package in November. The US Congress has passed an infrastructure spending package worth more than a trillion dollars in the same month. Another multi-trillion US budget measure could also pass Congress soon. The package(s) will have a stimulatory effect on the US economy during the outlook period (in 2022 and 2023) and beyond. The US Federal Reserve appears likely to move towards a neutral monetary policy stance as the US economic recovery gathers pace.

Commodity demand should thus show significant growth over the outlook period. Australian coal exporters are enjoying high prices, on the back of shortages in Asia and Europe. However, as global coal supply lifts and demand cools, prices are likely to decline noticeably from current levels.

Our projections suggest that resource and energy export earnings will reach $381 billion in 2021–22, but then fall back to around $310 billion in 2022–23. The extent of any further slowing in Chinese economic growth will impact on commodity demand and supply. Higher global interest rates — in response to persistent inflation — pose a downside risk to global economic activity and hence the resource and energy export forecasts.

1.4 Prices

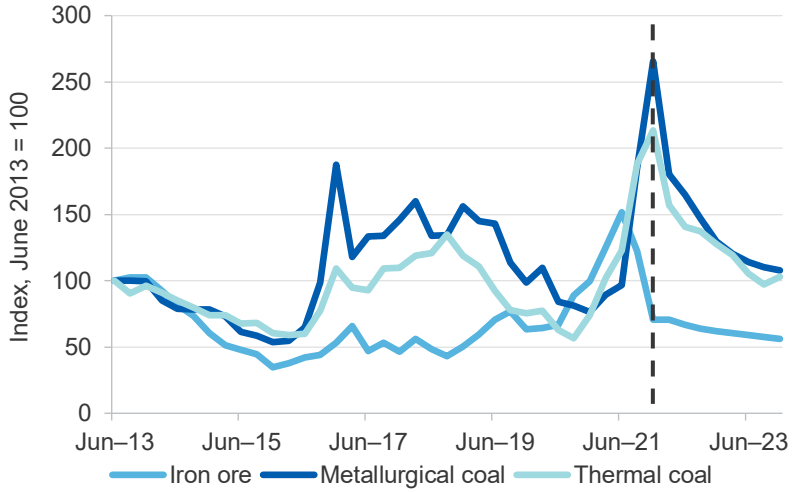
Since the September 2021 *Resources and Energy Quarterly*, the iron ore price has retreated further from the decade high of May 2021. Strong demand in some of the advanced industrialised nations has been unable to offset the impact of weaker Chinese demand (Figure 1.4). Prices are expected to ease further over the outlook period, as Brazilian supply recovers and growth in world demand slows further.

Australian metallurgical coal prices hit record highs in October/November despite the sharp downturn in iron ore prices. Australia's dominant position in the seaborne market has meant that China has been forced to compete vigorously for non-Australian cargoes. Moreover, the thin price differential between low grade metallurgical coal and thermal coal appears to have seen miners dump unwashed metallurgical coal into thermal coal markets. Prices are expected to ease over the outlook period, as supply rises. Thermal coal prices spiked in October, before China's move to raise its production and cap prices saw a retreat. With rebounding economic activity and the Northern Hemisphere winter under way, power utilities are scrambling to rebuild stocks. Prices are likely to hold at relatively strong levels, as supply struggles to keep up with winter demand (Figure 1.4).

Oil prices have more than regained the sharp falls of the COVID-19 pandemic. The oil price seems likely to be capped at US$85 a barrel over the forecast period, as a further recovery in usage is matched by rising supply. Contract LNG prices are forecast to ease, as oil prices settle.

The gold price held the US$1,750 an ounce mark in early October, and then rose impressively over the next month, topping out at over US$1,870 an ounce as real bond yields fell back. The price is likely to fall over the outlook period, as real bond yields rise on the back of withdrawal of central bank stimulus. In mid November 2021, all six metals traded on the London Metal Exchange were in backwardation — where spot prices exceed some/all prices further out the futures curve. Stockpiles have declined, as supply chain disruptions have added to the impact of strong demand (following the rebound in economic activity). Base metal usage should rise as world industrial activity recovers and as the energy transition continues.

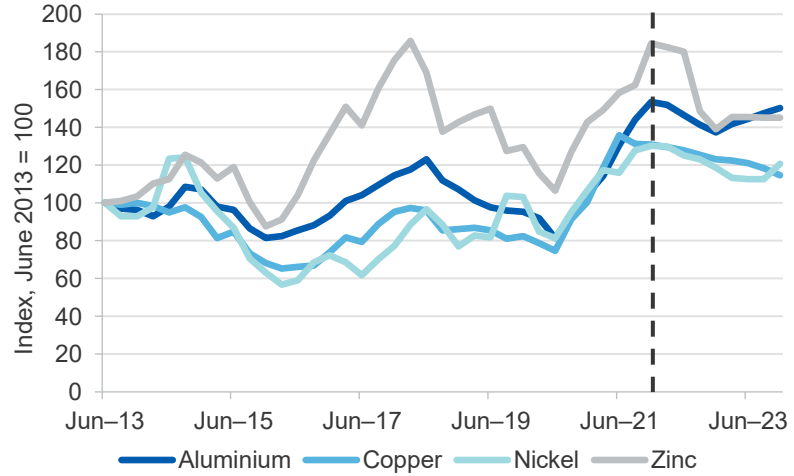
Figure 1.4: Bulk commodity prices



Notes: Prices are in US dollars, and are the international benchmark prices

Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021)

Figure 1.5: Base metal prices



Notes: Prices are in US dollars, and are the international benchmark prices

Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021)

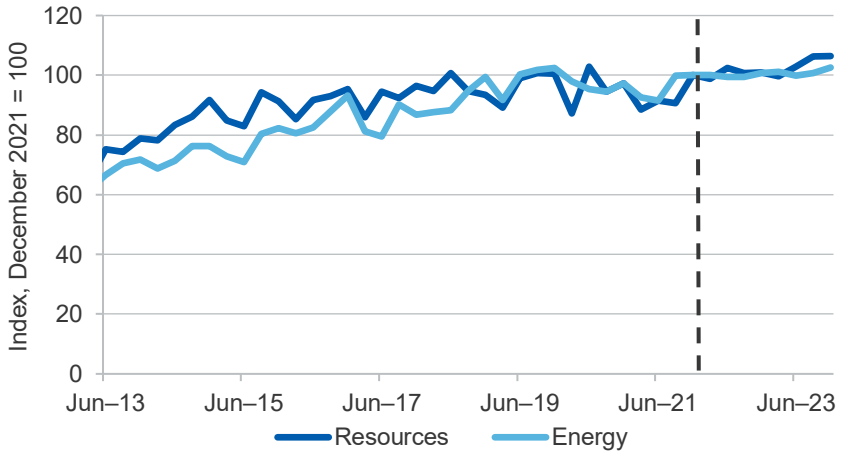
1.5 Export volumes

December quarter export volumes rose, driven by energy exports

The OCE's Resources and Energy Export Volumes Index (preliminary estimate) rose by 5% in the December quarter 2021 from the September quarter, and was 3% higher than a year before (Figure 1.6). Within this total, resource commodity volumes rose 3% in the year to the December quarter 2021, while energy commodity volumes also rose by 3%. The improvement in energy exports was driven by the rebound in demand, as energy stockpiles were replenished and the world economy (and thus power demand) gradually recovered from the impact of COVID-19.

In volume terms, resource exports are likely to show further significant growth over the outlook period. Economic growth and industrial production continues to recover amongst our main trading partners, increasing demand for our ferrous and non-ferrous metals. The production of electric vehicles and new energy technologies will see growing demand for commodities such as copper, aluminium, lithium and nickel. The volume of energy exports is forecast to show only minor growth during the outlook period. High prices will impact adversely on near-term demand.

Figure 1.6: Resource and energy export volumes



Source: Department of Industry, Science, Energy and Resources (2021)

1.6 Contribution to growth and investment

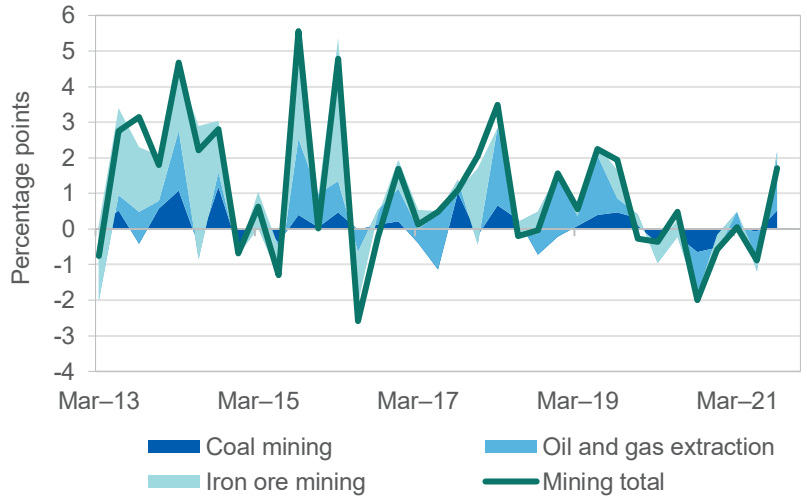
Mining industry expanded while the overall economy contracted

Australia's real Gross Domestic Product (GDP) fell by 1.9% in the September quarter 2021, but was up 3.9% over the year since the September quarter 2020.

Mining value-added rose by 1.7% in the September quarter, and was up 0.3% over the previous twelve months.

In the coming two years, it is likely that the resources and energy sectors will make a significant contribution to real GDP growth, as producers lift output and exports in response to high prices and margins. Absent a repeat of the operational problems that have beset gas production over the past year, the LNG sector is likely to make a significant contribution to growth in the outlook period, on the back of strong LNG demand and high prices.

Figure 1.7: Contribution to quarterly growth, by sector

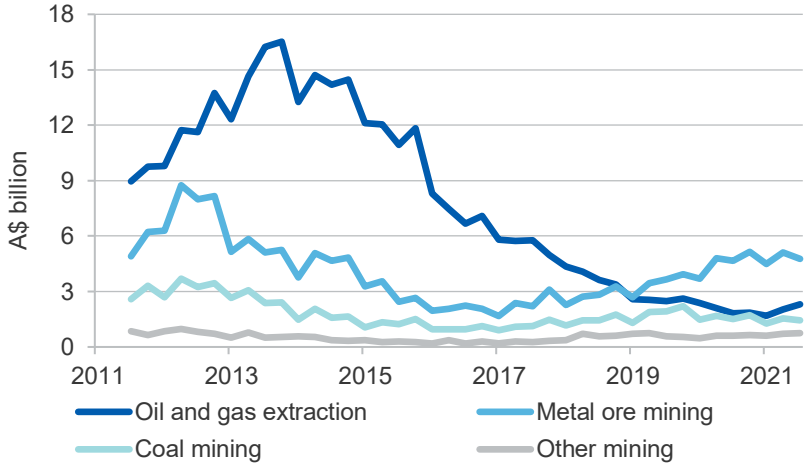


Source: ABS (2021) Australian National Accounts, 5206.0

Mining investment is picking up

The ABS Private New Capital Expenditure and Expected Expenditure survey of September quarter 2021 shows that Australia's mining industry invested $9.3 billion in the quarter. This was down by 1.7% in the quarter (seasonally adjusted), but up 7.6% from the September quarter 2020. Strong iron ore prices has supported growth in investment by the metal ore mining sector during 2021, though this is now easing back (Figure 1.8) with growth shifting now to the oil, gas and non-metallic minerals sectors.

Figure 1.8: Mining industry capital expenditure by commodity

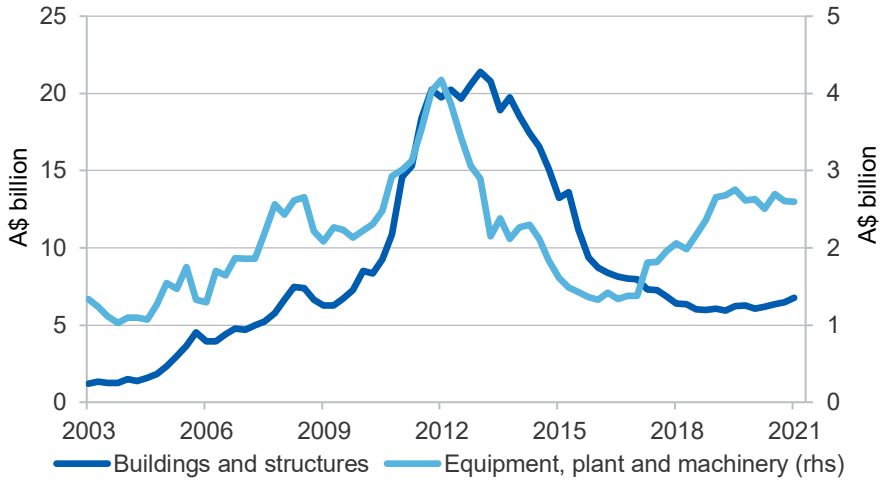


Notes: Other mining includes non-metallic mineral mining and quarrying and exploration and other mining support services; chart data is in nominal, original terms

Source: ABS (2021) Private New Capital Expenditure and Expected Expenditure, 5625.0

Expenditure lifted slightly for buildings and structures, while holding steady for machinery and equipment in the September quarter 2021 (Figure 1.9). Spending on plant and equipment remains well above its average level of recent years, though the reverse trend has been evident in buildings and structures. Forward expectations suggest that investment in 2021–22 will be slightly higher than in 2020–21 (Figure 1.10). Strong prices for gold and various minerals used in low-emissions energy have been leading to new investment plans, including the re-opening of mines.

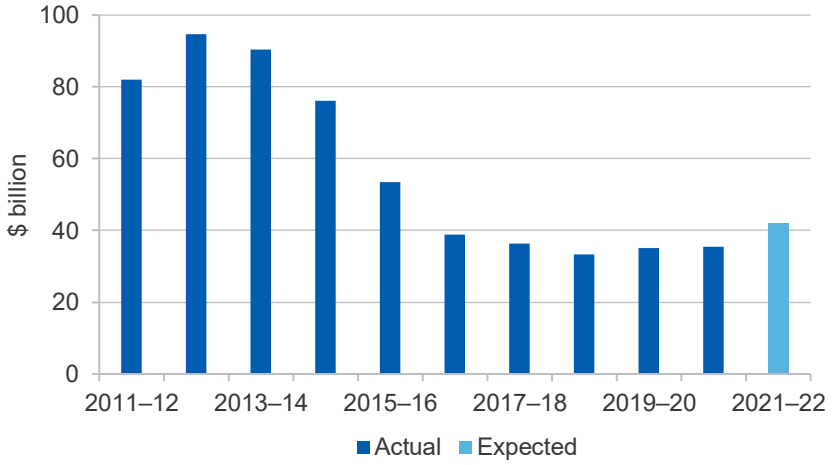
Figure 1.9: Mining industry capital expenditure by type, quarterly



Notes: Chart data is in nominal terms, seasonally adjusted.

Source: ABS (2021) Private New Capital Expenditure and Expected Expenditure, 5625.0

Figure 1.10: Mining industry capital expenditure, fiscal year

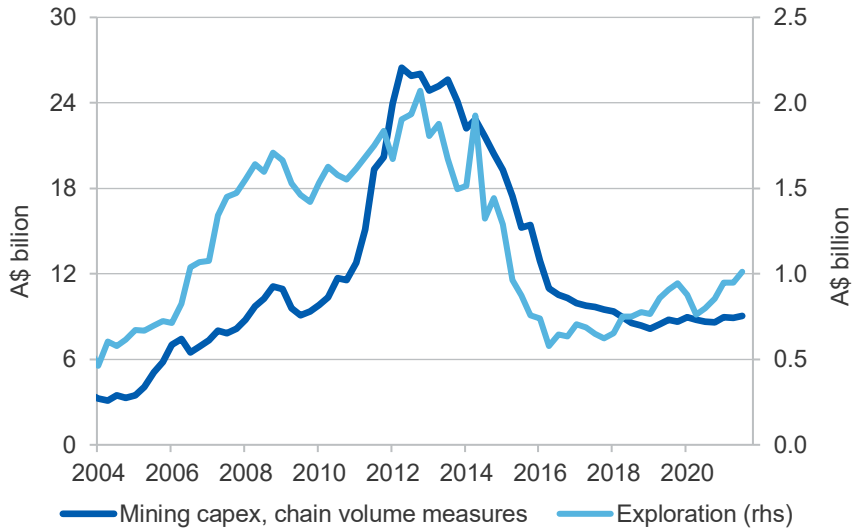


Notes: Chart data is in nominal terms

Source: ABS (2021) Private New Capital Expenditure and Expected Expenditure, 5625.0

Data on exploration spending (adjusted for inflation) suggests that mining capital expenditure continues to build up (Figure 1.11). Exploration spending rose from $949 million in the June quarter to $1,011 million in the September quarter. This was the fifth consecutive quarterly rise, representing a sustained lift from the recent low of $761 million in the June quarter 2020.

Figure 1.11: Mining capital expenditure vs exploration, quarterly



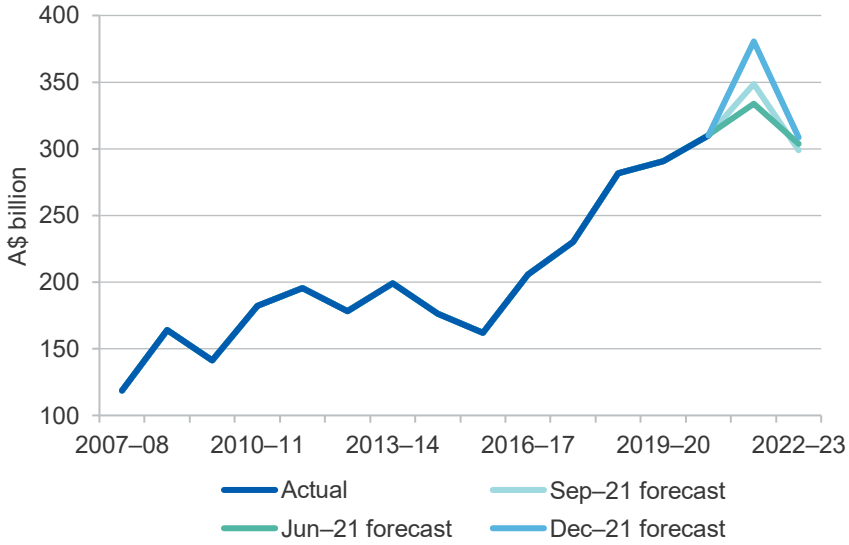
Source: ABS (2021) Private Capital Expenditure Survey, Chain Volume measure, 5625.0

1.7 Revisions to the outlook

At $379 billion, the forecast for Australia's resources and energy exports in 2021–22 is $31 billion higher (in nominal terms) than those contained in the September quarter 2021 *Resources and Energy Quarterly* (REQ). An unprecedented surge in coal prices, and stronger oil and base metal exports, have more than offset downward revisions to iron ore earnings in 2021–22.

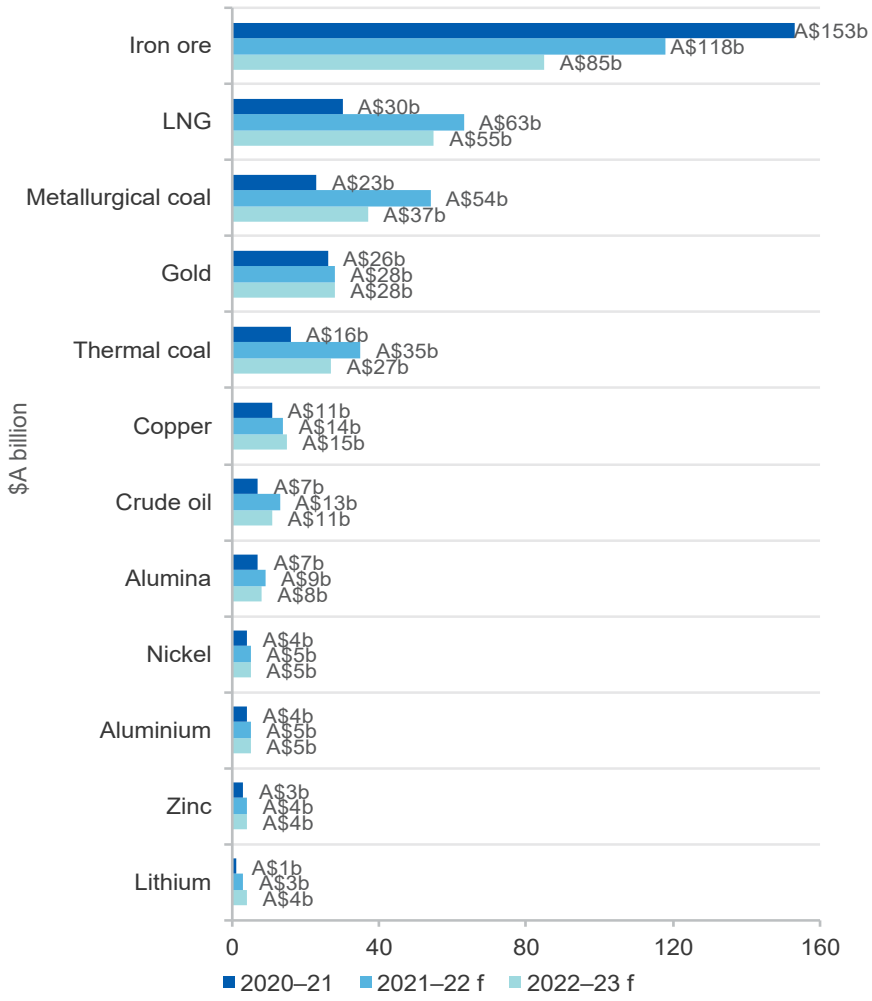
The forecast for $311 billion in export earnings in 2022–23 is up $12 billion from the September quarter 2021 REQ. Downward revisions to iron ore prices (and hence earnings) have been more than offset by the impact of improved energy earnings in 2022–23.

Figure 1.12: Resource and energy exports, by forecast release



Source: Department of Industry, Science, Energy and Resources (2021)

Figure 1.13: Australia's major resources and energy commodity exports, nominal



Annual per cent change

	2021–22 f			2022–23 f		
	volume	EUV	value	volume	EUV	value
Iron ore	▲ 5	▼ -27	▼ -23	▲ 3	▼ -28	▼ -25
LNG	▲ 7	▲ 94	▲ 106	▲ 3	▲ 31	▲ 35
Metallurgical coal	▲ 2	▲ 130	▲ 135	▲ 3	▲ 23	▲ 27
Gold	▲ 21	▼ -11	▲ 9	▲ 15	▼ -10	▲ 4
Thermal coal	▲ 8	▲ 105	▲ 122	▲ 3	▲ 27	▲ 31
Copper	▼ -2	▲ 26	▲ 24	▲ 2	▲ 11	▲ 13
Crude oil	▲ 11	▲ 53	▲ 69	▲ 4	▲ 18	▲ 23
Alumina	▼ -3	▲ 30	▲ 26	▼ -2	▲ 10	▲ 8
Nickel	▲ 42	▼ -4	▲ 37	▲ 23	▼ -8	▲ 13
Aluminium	▲ 6	▲ 36	▲ 44	▲ 3	▲ 12	▲ 16
Zinc	▼ -9	▲ 35	▲ 24	▲ 1	▲ 3	▲ 4
Lithium	▲ 29	▲ 143	▲ 214	▲ 21	▲ 64	▲ 99

Notes: f forecast. EUV is export unit value. Per cent change is from 2020–21.
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Table 1.1: Outlook for Australia's resources and energy exports in nominal and real terms

					Annual percent change			
Exports (A$m)	2019–20	2020–21	2021–22[f]	2022–23[f]	2019–20	2020–21	2021–22[f]	2022–23[f]
Resources and energy	290,686	309,999	379,179	310,647	3.2	6.6	22.3	–18.1
– real[b]	302,553	317,508	379,179	304,085	1.8	4.9	19.4	–19.8
Energy	115,532	81,178	170,689	136,106	–12.9	–29.7	110.3	–20.3
– real[b]	120,249	83,144	170,689	133,231	–14.1	–30.9	105.3	–21.9
Resources	175,154	228,821	208,490	174,541	17.6	30.6	–8.9	–16.3
– real[b]	182,304	234,364	208,490	170,854	16.0	28.6	–11.0	–18.1

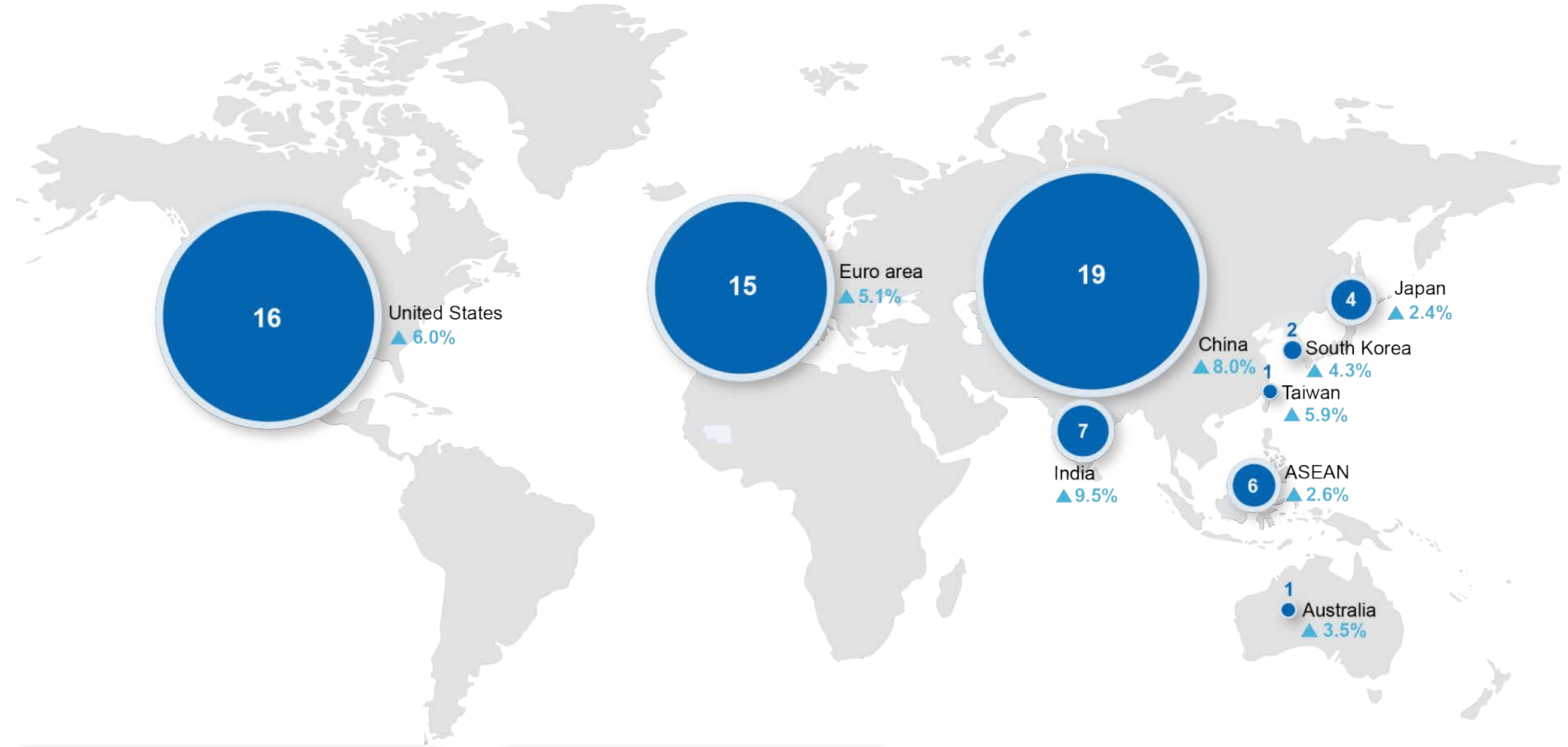
Notes: **b** In 2020–21 Australian dollars; **f** forecast; **r** Compound annual growth rate; **z** projection.
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Table 1.2: Australia's resource and energy exports, selected commodities

	Prices				Export volumes				Export values, A$b		
	Unit	2020–21	2021–22[f]	2022–23[f]	Unit	2020–21	2021–22[f]	2022–23[f]	2020–21	2021–22[f]	2022–23[f]
Iron ore	US$/t	140	100	74	Mt	867	911	920	153	118	85
LNG	A$/GJ	7.5	14.4	12.7	Mt	77	82	82	30	63	55
Metallurgical coal	US$/t	123	284	183	Mt	171	175	181	23	54	37
Thermal Coal	US$/t	76	149	105	Mt	192	208	204	16	35	27
Gold	US$/oz	1,850	1,791	1,738	t	283	344	377	26	28	28
Copper	US$/t	7,971	9,278	8,793	Kt	898	880	934	11	14	15
Crude oil	US$/bbl	54	75	70	Kb/d	276	306	300	7.4	13	11
Alumina	US$/t	284	359	339	Kt	18,600	18,065	17,888	6.9	8.8	8.2
Aluminium	US$/t	2,029	2,736	2,593	Kt	1,357	1,438	1,452	3.8	5.4	5.1
Nickel	US$/t	16,267	19,197	17,516	Kt	181	257	272	3.8	5.2	4.8
Zinc	US$/t	2,657	3,264	2,663	Kt	1,392	1,273	1,409	3.3	4.1	3.6
Lithium	US$/t	452	1,044	1,085	Kt	1,714	2,215	2,515	1.1	3.3	4.2
Uranium	US$/lb	30	43	47	t	5,830	4,871	5,480	0.6	0.5	0.6

Notes: **a** Export data covers both crude oil and condensate; **f** forecast. **Price information:** Iron ore fob (free-on-board) at 62 per cent iron content estimated netback from Western Australia to Qingdao China; Metallurgical coal premium hard coking coal fob East Coast Australia; Thermal coal fob Newcastle 6000 kc (calorific content); LNG fob Australia's export unit values; Gold LBMA PM; Alumina fob Australia; Copper LME cash; Crude oil Brent; Aluminum LME cash; Zinc LME cash; Nickel LME cash; Lithium spodumene ore.
Source: ABS (2021) International Trade in Goods and Services, Australia, Cat. No. 5368.0; LME; London Bullion Market Association; The Ux Consulting Company; US Department of Energy; Metal Bulletin; Japan Ministry of Economy, Trade and Industry; Department of Industry, Science, Energy and Resources (2021)

Macroeconomic Outlook



In 2020, world economic growth contracted by 3.1% due to COVID-19. Increasing containment of COVID-19 and economic stimulus are expected to support growth of 5.9% in 2021.

Risks include slow or limited vaccine rollouts, as well as additional COVID-19 strains. Over the medium term rising inflationary pressures pose a risk.

● = Share of global GDP

▲ = Economic growth in 2021

▼ = Economic contraction in 2021

2.1 Summary

- The global recovery continues, sustained by the ongoing rollout of COVID-19 vaccines and continued fiscal and monetary support across major economies.
- However, the pace of recovery has slowed in recent months. While this follows a moderation of growth rates toward long-run trend levels as the recovery progresses, it also reflects near-term impacts from the pandemic. This includes renewed outbreaks of COVID-19 and energy shortages across many regions, and ongoing supply chain disruptions.
- After growth of 5.9% in 2021, world economic growth is forecast to ease to 4.9% in 2022 and 3.6% in 2023, as levels of pent up demand recede, and governments and central banks continue to withdraw stimulus policies.

2.2 World economic outlook

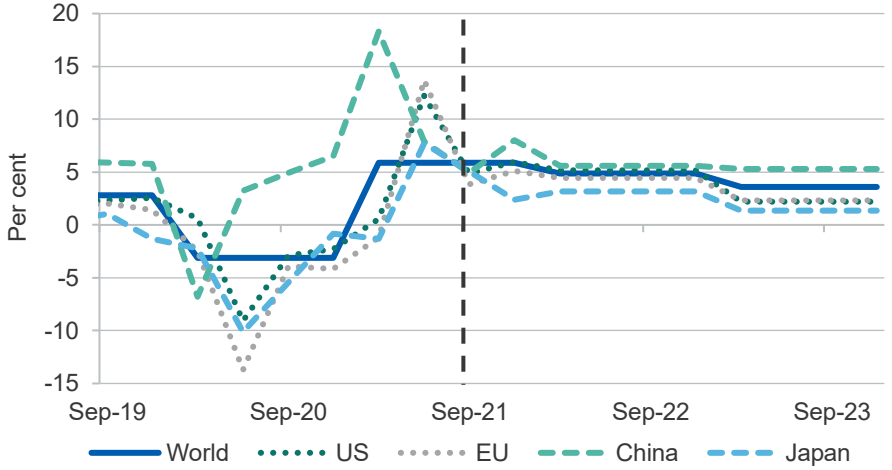
Global recovery remains underway, despite ongoing impacts of pandemic

In its October 2021 Outlook, the International Monetary Fund (IMF) projects the world economy to grow by 5.9% in 2021 (Figure 2.1). This is a slight downward revision (of 0.1 percentage points) from its July 2021 update. The revised projection accounts for the impact of the recent waves of the pandemic across many regions, as well as the persistence of global supply chain constraints, as the global demand for goods has recovered to pre-pandemic levels.

The IMF has highlighted the key role that (disparities in) vaccination rates continue to play in the diverging recoveries seen across different countries and regions. Advanced economies — with almost 60% of their populations fully vaccinated by the end of October — are expected to return to their pre-pandemic trend growth path by 2022. In comparison, output in emerging market and developing economies is now expected to be 5.5% below the pre-pandemic forecast in 2024.

Amongst advanced economies, the US, Germany and Japan have had 2021 growth projections revised down from the July 2021 Outlook, due to

Figure 2.1: GDP growth forecasts



Source: Bloomberg (2021); IMF (2021)

near-term impacts of the pandemic. However, advanced economies are expected to make a stronger recovery in the first half of 2022, as vaccination rates improve. China's projected growth has also been revised down in both 2021 and 2022 (by 0.1 percentage points), due to a stronger-than-expected scaling back of fiscal support this year.

Ongoing fiscal and monetary accommodation continues to be a driver of the faster recovery of many advanced economies. Significant fiscal packages in economies such as the US, EU, United Kingdom and Japan, are expected to continue to offset ongoing COVID-19 impacts, and boost economic growth into 2022.

World economic growth is expected to moderate over the outlook period. Global growth is forecast to reach 4.9% in 2022, with a further easing to 3.6% in 2023, as pent up demand in the global economy recedes and government support is removed. However, there remain significant risks to this recovery path. Renewed waves of the pandemic have contributed to lower global growth in the September and December quarters of 2021, and remain a risk to ongoing recovery in the near-term. Supply chain

constraints are also creating inflationary pressures that could hamper global growth over the outlook period. An emerging risk is the impact of Chinese policy measures adopted in 2020 and early 2021, aimed at deleveraging its residential property sector — though there are recent signs these measures are now starting to be wound back.

Strong growth in global trade and production expected despite disruptions

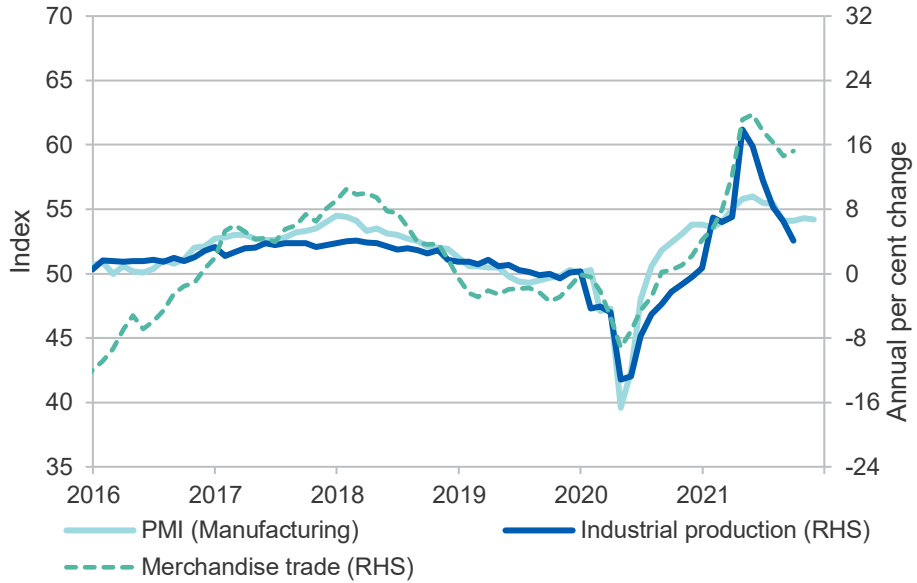
The outlook for Australia's major trading partners remains positive, with growth forecast to reach 6.0% in 2021 and 5.0% in 2022. In its October 2021 Outlook, the World Trade Organisation predicts merchandise trade volumes to grow by 10.8% in 2021, a significant upward revision from 8.0% forecast in March this year.

This improved outlook comes despite a number of supply-side issues that have intensified through 2021. For example, the current shortage in semiconductor chips is now expected to persist into 2022. Supply chain disruptions (such as port delays and container shortages) and high shipping costs are all also stunting the recovery in global trade. These issues have seen a marginal slowing of growth in merchandise trade in recent months, falling from a peak of 20% year-on-year in April 2021, to 15% year-on-year in September 2021 (Figure 2.2).

Global industrial production has rebounded impressively in 2021, and was 4.1% higher year-on-year in September (Figure 2.2). However, the rate of recovery also appears to be slowing, with global industrial output in the September quarter falling 0.2% quarter-on-quarter. While this is consistent with a return to more moderate, longer-run growth rates, it also reflects near-term disruptions that have persisted in many nations in 2021 as a result of the COVID-19 pandemic and supply chain issues.

The Global Manufacturing Purchasing Managers Index (PMI) was 54.2 in November, marking improved business conditions for 17 consecutive months. However, firms continue to report rising inputs costs (near their highest ever levels), stalled international trade flows, and supplier delays — which reached their highest levels on record in October.

Figure 2.2: World industrial production, trade and PMI



Notes: PMI data is to November 2021; IP and trade data only available to September 2021
Source: IHS Markit (2021); CPB Netherlands Bureau for Economic Policy Analysis (2021)

Global services trade — while still below pre-pandemic levels — has seen continued improvement in recent months, and is helping to offset the weaker expansion in merchandise trade. This includes strong growth in the business, consumer and financial services sectors. As COVID-related movement restrictions ease in many countries, services activity, commuting and leisure travel, are all expected to continue strength growth into 2022. However, services industries remain susceptible to renewed outbreaks over the outlook period.

Ongoing global supply chain disruptions increasing inflationary pressures

The robust recovery in world trade and industrial production in 2021 has continued to put pressure on global supply chains, as the rebound in global demand has consistently outpaced the recovery in supply.

The comparatively stronger financial position of many households in advanced economies coming out of the pandemic — due to sizeable fiscal support, increased household savings rates, and growth in asset prices — has seen a significant surge in global consumption levels. This has been further propelled by the shift in household preferences toward goods consumption since the start of the pandemic.

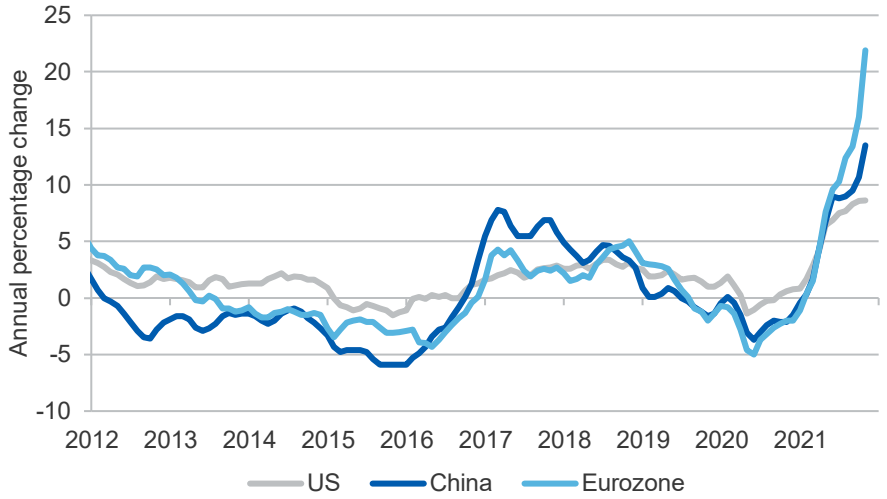
However, renewed outbreaks of the COVID-19 pandemic — particularly in Asia — continued to stifle global supply chains in the second half of 2021. Port delays, high shipping costs and other transportation shortages are all also creating persistent disruptions to the global recovery.

The current shortage in semiconductor chips provides a notable example of the impacts from these disruptions. Estimates suggest the shortage will lead to 7.7 million fewer vehicles being made in 2021, and cost the automotive industry more than $200 billion in lost revenue. Impacts have also affected other industries such as medical equipment, computers, and other electronics. The shortage is now expected to persist well into 2022.

Congestion at major destination ports in Europe and the US has also intensified in recent months, contributing to increased delivery delays and rising input costs. In October, average vendor delivery times (measured through the JPMorgan Global Manufacturing PMI) were the longest on record. Combined with other cost pressures, this has led to input prices increasing at their fastest pace in over a decade (Figure 2.3).

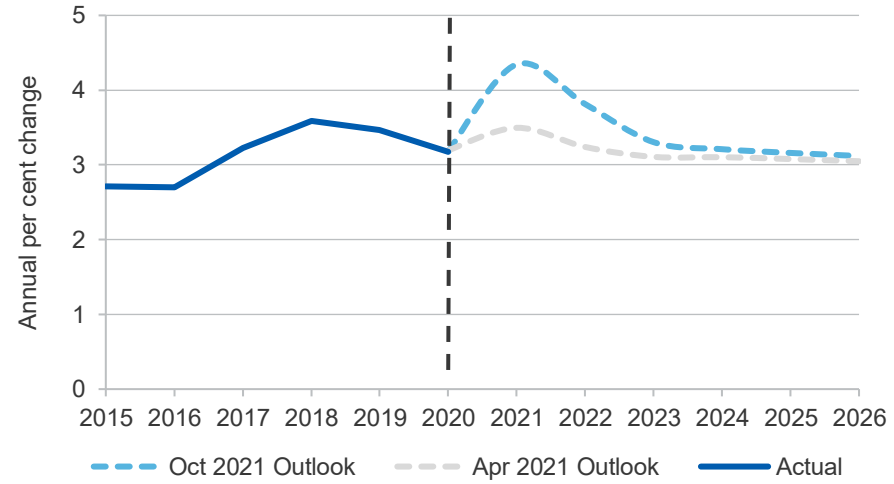
The persistence of price pressures has caused the IMF to increase its inflation projections in its most recent Outlook. Inflation is now forecast to reach 4.3% in 2021, and 3.8% in 2022 (Figure 2.4). Inflationary pressures have also prompted a number of central banks to begin normalising monetary policy. Central banks in the Czech Republic, Poland and South Korea have all raised rates in recent months. And the Bank of England and Bank of Canada have also flagged potential interest rate increases in the next few quarters, raising the risk of potential checks to the pace of the global recovery over the outlook period.

Figure 2.3: Producer Price Indices – US, China and Eurozone



Source: Bloomberg (2021); Board of Governors of the Federal Reserve System (2021); U.S. Bureau of Economic Analysis (2021)

Figure 2.4: IMF projections of global inflation



Source: IMF (2021)

2.3 Major trading partners' economic outlook

China's recovery hindered in Q3 by new outbreaks and energy shortages

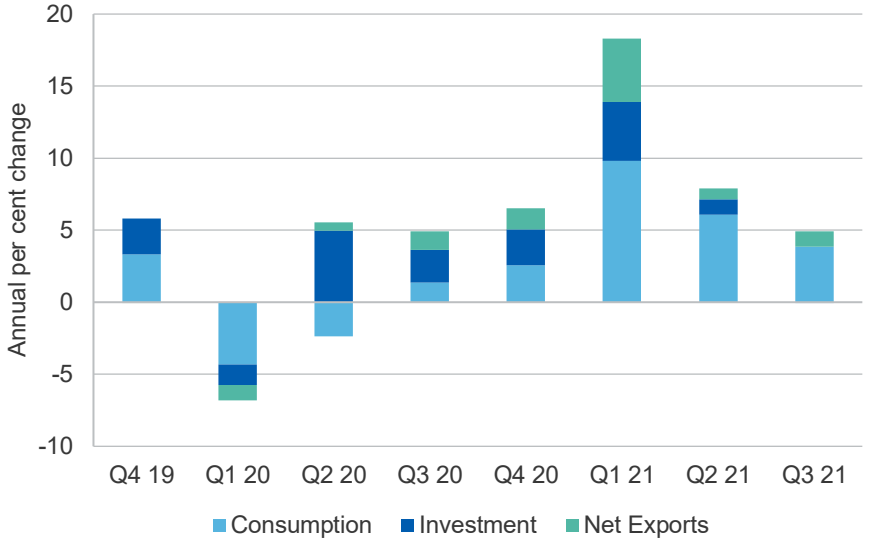
China's economy grew by 4.9% year-on-year in the September quarter 2021, its slowest rate of growth in over 12 months. Renewed outbreaks of the pandemic have impacted economic activity in recent months, along with acute energy shortages and policy decisions aimed at deleveraging the domestic property sector (see *Steel* chapter). Growth in the September quarter 2021 was primarily driven by domestic consumption (public and private combined) and exports (Figure 2.5). By industry, sectors such as Information Technology (17.1% growth year-on-year) and Wholesale and Retail Trade (7.6% year on year) saw the biggest expansions.

The considerable surge in China's industrial output in the first half of 2021 — as the country emerged from the pandemic — now appears to be easing. Industrial production grew by 3.5% year-on-year in the month of October, down from a high of 14% in March 2021. Sentiment improved in China's official manufacturing PMI in November, reaching 50.1 and marking a reversal from the contraction (readings below 50) seen for the two previous months. However, the Caixin-Markit Manufacturing PMI — a broader-based survey of over 500 companies — fell into contractionary territory in November, with a reading of 49.9.

Chinese manufacturers have highlighted the deleterious impact that power shortages and rising costs have had on industrial output in recent months. Coal shortages have led to power rationing and forced blackouts in more than half of China's 31 provinces from September this year, severely restricting the country's industrial activity during the period (see *Thermal Coal* chapter). While the shortages appear to have relented as of late November, inflationary pressures are expected to remain elevated in the short term. Lead times for inputs in October increased at their fastest rate since March 2020, and input costs rose for the 17th consecutive month.

The September quarter 2021 also saw a contraction in China's construction and real estate sectors (-1.8 and -1.6% year-on-year respectively). This follows recent efforts by the central government to

Figure 2.5: Contributions to China's quarterly real GDP growth



Notes: Consumption is made up of both household and government sectors.
Source: Bloomberg (2021); National Bureau of Statistics of China (2021)

deleverage the residential property market. The introduction of the 'Three Red Lines' policy in late 2020 has seen investment in real estate weaken in 2021 and a number of private developers face funding pressures during the year, most notably China Evergrande. Following falls in property prices and construction starts in recent months, the government and central bank have intervened to stem the weakness in the sector. However, a downturn in residential activity remains a risk over the outlook.

The slowdown in economic growth in the September quarter 2021 and ongoing concerns about China's property sector has seen growing market expectations of a return of fiscal and monetary stimulus — particularly infrastructure investment — in the near term. However, at the end of October total infrastructure investment (three month moving average, year-on-year) was 5.3% lower than 12 months previous. And Total Social Financing — a broad measure of credit and liquidity in the economy — in

the 10 months to October 2021 was also around 15% lower than the same period in 2020.

Following recent outbreaks of the pandemic in the second half of 2021, as well as the continued removal of fiscal stimulus, the latest IMF forecasts put China's growth at 8.0% in 2021. This is a 0.1 percentage point reduction compared with the IMF's July 2021 Outlook. China's economic growth is then forecast to ease to 5.6% in 2022. Renewed outbreaks of the pandemic remain a significant downside risk in the near term. High case numbers in October and November — affecting more than half of China's 31 provinces — could stymie growth further in coming months. A resumption of energy shortages, or a deterioration in China's residential property market could also impact on growth over the outlook.

Recent wave of COVID-19 and supply shortages delay Japan's recovery

Due to a severe wave of the COVID-19 pandemic through the summer, Japan's economy contracted by an annualised 3.6% year-on-year in the September quarter 2021. This was also the fifth contraction of the Japanese economy (quarter-on-quarter) in the last eight quarters.

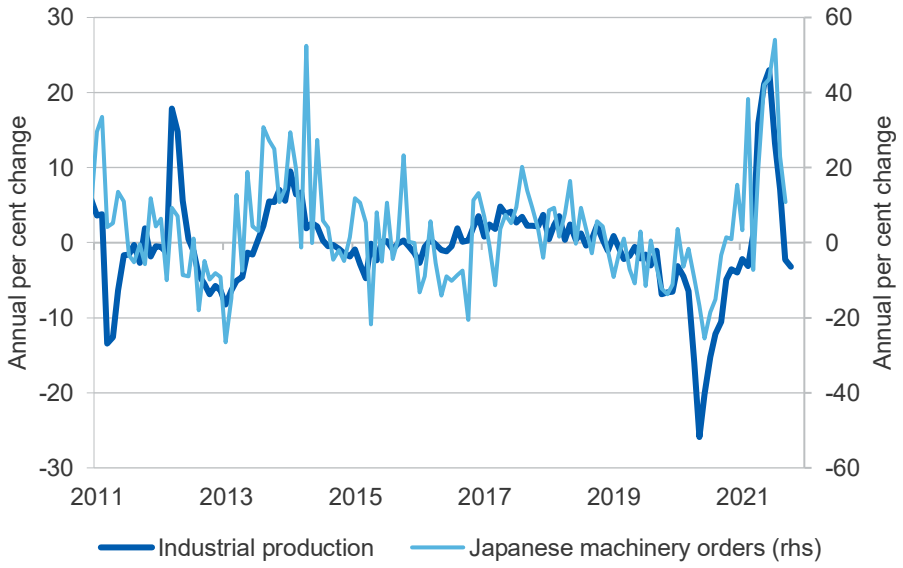
After a rapid expansion in the first half of 2021, industrial production fell 3.2% year-on-year in October 2021. This follows slowing growth in machinery orders and exports in recent months (Figure 2.6). Despite the recent contraction in output, lead indicators continue to suggest a positive outlook for economic activity in the December quarter 2021, as COVID-19 case numbers fall and containment measures are relaxed. The Jibun Bank Manufacturing PMI for Japan rose to 54.5 in November (from 53.2 in September), marking 10 consecutive months of expansion. Jibun Bank's Japan Services PMI also returned to expansionary territory for the second consecutive month, reaching 53.0 in November. This included business activity rising at its fastest pace for 27 months.

Manufacturers continue to highlight the presence of considerable supply chain issues and the inflationary pressures this is creating. Raw material shortages have led to a sharp increase in input prices in recent months, and have contributed to factory gate inflation reaching 13-year highs.

Many firms are also flagging the potential for rising staff costs over the coming 12 months.

The IMF is now projecting Japanese economic growth of 2.4% in 2021. This is a fall of 0.4 percentage points from the July 2021 Outlook, reflecting the impacts of the COVID-19 pandemic through the September quarter 2021. However, Japan is expected to see a stronger rebound in coming quarters, as vaccinations are rolled out and the economy returns to normal, with the IMF forecasting growth to reach 3.2% in 2022, before slowing to 1.4% in 2023. The recovery will be further aided by an additional ¥78.9 trillion (around US$690 billion) stimulus package unveiled by Prime Minister Kishida in the second half of November.

Figure 2.6: Japan industrial production and machinery orders



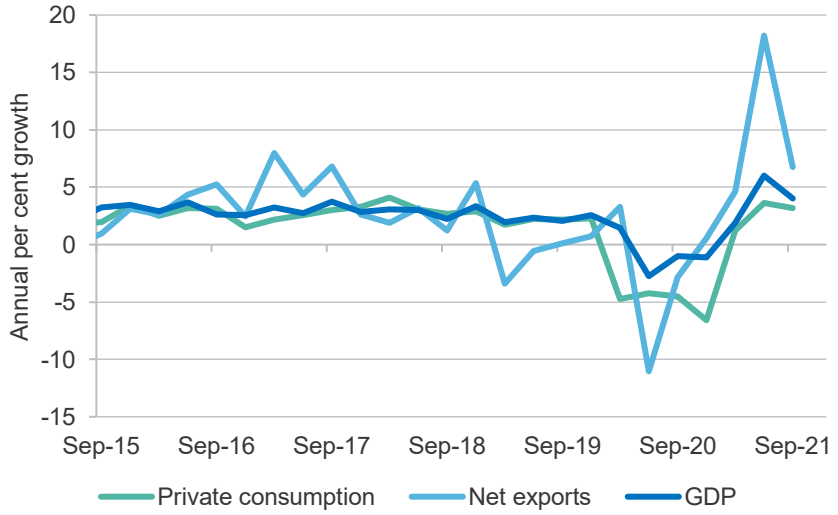
Notes: IP data is to October 2021; machinery orders data only available to September 2021
Source: Bloomberg (2021)

Softer growth for South Korea in Q3 on renewed COVID-19 outbreaks

South Korea's economy grew by 4.0% year-on-year in the September quarter 2021. The softening pace compared with the June quarter 2021 (6.0% growth year-on-year) follows renewed outbreaks of the pandemic and strict containment measures instituted from July this year (Figure 2.7). Exports continued to help to drive growth in the South Korean economy in the September quarter, with growth in net exports of 6.8% year-on-year. Household demand also remained resilient, growing 3.2% year-on-year.

The renewed COVID-19 outbreaks has led to weakness in the manufacturing sector, with industrial production falling by 1.9% year-on-year in the month of October. South Korea's manufacturing PMI reading in November was 50.9, a slight improvement on October (at 50.2), however marked a second consecutive decrease in manufacturing output. Firms have highlighted raw material shortages and ongoing supply chain issues as having contributed to a broad stagnation in operating conditions.

Figure 2.7: South Korean GDP, consumption and trade



Source: Bloomberg (2021)

Despite the softer pace of recovery, rising price pressures have seen the Bank of Korea begin to raise policy rates, with a 25 basis points increase in both August and November this year. Against a back drop of comparatively high levels of household debt (amongst advanced economies), managing this normalisation of monetary policy and maintaining economic activity and sentiment presents a key challenge over the outlook period.

The IMF forecasts South Korea's economy to grow by 4.3% in 2021, and 3.3% in 2022, sustained by the ongoing recovery of global economic activity and trade. This is unchanged from the IMF's July 2021 Outlook. South Korea's economic growth is then forecast to ease to 2.8% in 2022. Renewed outbreaks of the pandemic — and its impact on global demand for goods amongst South Korea's major trade partners — will continue to be a key risk for the economy in the December 2021 quarter and into 2022.

India's recovery slows in Q3 due to fading base effects and weaker output

Following a record pace of expansion in the first quarter of India's new financial year (April – June 2021), India's growth has slowed to 8.4% year-on-year in the September 2021 quarter (Figure 2.8). This reflects a fading base effect — with the fall in economic activity most acute in the June quarter 2020 — as well as softening domestic demand and merchandise exports.

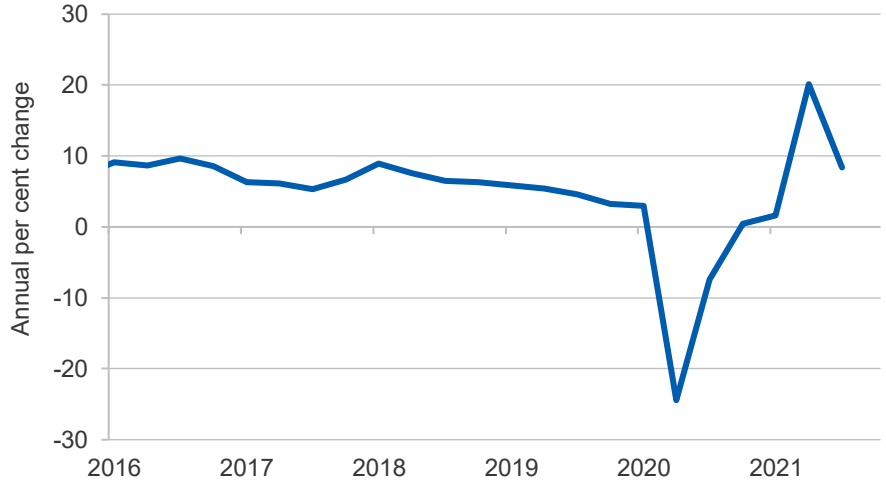
While the pace of growth has eased, India's economy continues to steadily recover, as COVID-19 cases drop and mobility and activity in the services sector recovers. India's manufacturing industry — which contributes around 16% of the country's GDP — grew by 5.5% year-on-year ib the September 2021 quarter. Over the same period, the Trade, Hotels, Transport & Communication industry (around 17% of the country's GDP) grew by 8.2% year-on-year, and construction (around 7% of GDP) grew by 7.5%.

Following rapid expansion in industrial activity in the first half of 2021, growth in industrial production in October has slowed to 3.1% year-on-

year, with weaker output in industries such as mining and quarrying, manufacturing and utilities. This is due to a number of rising supply side issues, most notably a severe power shortage from shortages of thermal coal (see *Thermal Coal* chapter).

Despite the recent disruptions, the business outlook remains positive, with India's composite PMI in October (combining manufacturing and services) reaching its highest level since 2012. India's manufacturing PMI has further increased in November, with a reading of 57.6. This marked five consecutive months of expansion. Manufacturing activity is expected to continue expanding into the end of 2021, with stronger business confidence and a pick-up in new orders. However, rising input costs remain a growing concern for Indian manufacturers, increasing in recent months at their fastest rate in close to 8 years. These costs have mostly not been passed on yet (in the form of output cost rises) containing inflation for the time being, though the risk remains.

Figure 2.8: India quarterly GDP



Source: Bloomberg (2021)

India's Services PMI has also recorded its third fourth consecutive month of expansion, with a reading of 58.1 in November. While this marks a slight slowing in pace from October, it remained the second fastest rate of expansion in over a decade, and follows a reopening of the economy and renewed mobility. Indian services firms have continued to identify elevated input cost pressures, with higher fuel, material, staffing and transportation costs. Firms have also indicated that a growing share of the high cost burden firms, with a larger share of cost burdens now being passed to customers.

The IMF forecasts India's economic growth at 9.5% in 2021, unchanged from its July 2021 Outlook. This reflects expectations of a stronger recovery from the second half of 2021, as market confidence and demand conditions rebound. India's economy is subsequently forecast to grow by 8.5% in 2022 and 6.6% in 2023.

Slowing US growth in Q3, due to disrupted supply and weak consumption

The pace of US recovery eased in the September quarter 2021, with the economy growing at an annualised rate of 2.1%. This follows a new wave of the pandemic from the late summer, intensifying supply chain issues, and a marked weakening in the level of household consumption.

The release of pent up demand was a major driver of the US recovery in the first half of 2021, with household spending for both goods and services exceeding their pre-pandemic levels by June this year (Figure 2.9). While initially supported by a number of rounds of fiscal stimulus spending, record levels of private savings accumulated during the pandemic (close to US$4 trillion as of March 2021) also contributed to the significant rise in household consumption in recent quarters.

However, private consumption has slowed considerably in the September quarter 2021, growing by just 1.6% on an annualised basis (compared with 12% growth in the June 2021 quarter). This follows a further wave of the COVID-19 pandemic through the late summer, and the drawdown of household savings.

The release of pent up demand in the first half of the year contributed to the significant and ongoing supply chain disruptions seen through 2021. The backlog of cargo ships at many US ports remain at historic highs, and labour shortages in the transportation and logistics sectors are exacerbating issues with destination supply chains.

This has led to growing shortages of goods, and spiking prices. With much of the release of pent up demand and net private savings now returning longer-run levels, growth in household demand for goods is expected to ease from its elevated levels going into 2022.

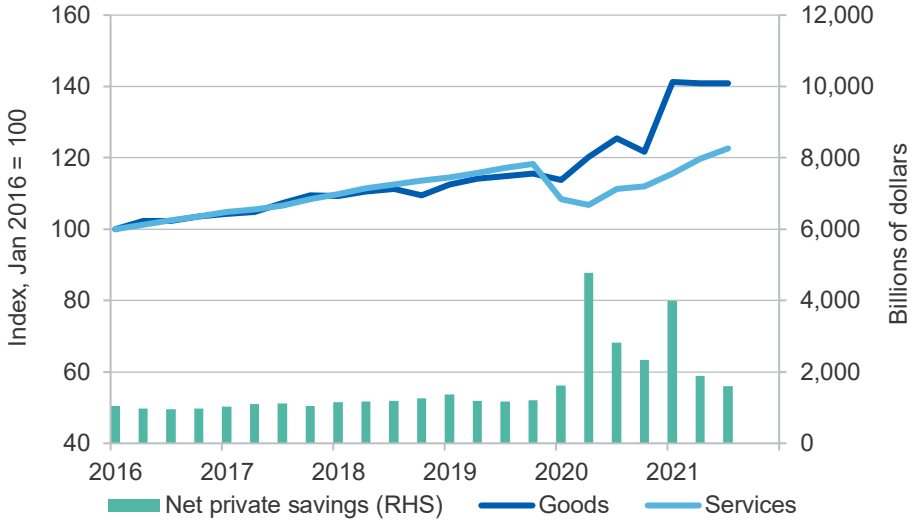
US industrial output expanded by 5.1% in the month of October, however this marked six months of slowing growth. The US Manufacturing PMI index remained in expansionary territory (with a reading of 58.4) in November, but was the second weakest rise in production over the past 14 months. Severe supplier delays and a shortage of components continues to constrain output, with significant numbers of manufacturers citing constrained production. This has led to a record rise in output prices, suggesting inflationary pressures are unlikely to abate in the next few months.

After contracting 3.4% in 2020, the IMF forecast US economic growth at 6.0% in 2021. This is a reduction of 1.0 percentage point compared with the July 2021 Outlook. The downward revision was due to softening consumption in the September quarter 2021 and ongoing supply chain disruptions. Projected growth in 2022 has increased to 5.2% and 2.2% in 2023, following President Biden signing the US$1.2 trillion Infrastructure Investment and Jobs Act into law in early November (see *Steel* chapter). Together with the proposed Build Back Better Framework currently under consideration in the US Senate, this would mean around $4 trillion in additional government spending over the next 10 years.

Europe recovery hampered by supply chain disruptions

Increasing vaccination rates and the reopening of economies saw the EU recovery continue in the September quarter 2021, with the economy

Figure 2.9: US personal consumption and net private savings



Notes: Personal Consumption Expenditures; seasonally adjusted data; January 2016 =100

Net private saving: Households and institutions, Billions of Dollars, Quarterly (End of quarter), Seasonally Adjusted Annual Rate

Source: U.S. Bureau of Economic Analysis (2021)

growing by 2.1% quarter-on-quarter (Figure 2.10). This put growth at 3.9% year-on-year, down from 13.7% in the June quarter.

Accommodative fiscal policies and COVID-19 support schemes have helped to support employment and bolster household balance sheets throughout the COVID-19 pandemic. However, rising case numbers and uneven vaccination rates across Eurozone member countries going into the December quarter 2021 means continued risk to the European recovery in the near-term.

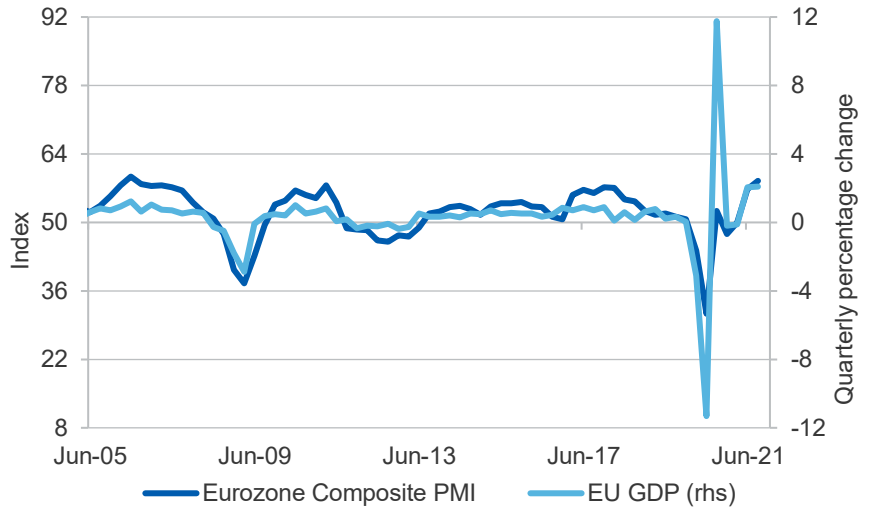
The Eurozone PMI Services Business Activity Index reading was 56.6 in November, marking a three month high. Prolonged supply disruptions and high energy prices have also impacted the European economy in recent months. Headline inflation in the Eurozone reached 4.1 percent (year-on-year) in October 2021. Energy prices have been the major driver of these

inflationary pressures, with shortages of oil and gas leading to prices hitting multi-year highs in recent months (see *LNG* chapter).

The strong rate of recovery in manufacturing in Europe is passing — with industrial production in the Eurozone falling by 0.2% month-on-month in September. This saw industrial output on an annualised basis also fall from 8.0% to 5.1% over the same period. The Eurozone Manufacturing PMI reading of 58.4 in November marked a small rebound from October, which had seen the weakest rate of expansion since February 2021. Producers have reported a worsening of supply chain issues in recent months, including a lack of shipping containers, port congestion and driver shortages. This has led to the weakest rise in output in over 12 months, and inflationary pressures reaching new highs.

The IMF now forecasts Eurozone economic growth at 5.0% in 2021, a 0.4 percentage point increase from its July 2021 Outlook. This reflects the improving health situation and easing of containment measures from the June and September quarters. Beyond 2021, the speed of the recovery is forecast to normalise, with growth of 4.3% projected in 2022 and 2.0% in 2023.

Figure 2.10: Eurozone GDP and Composite PMI (quarterly)



Source: Bloomberg (2021)

Table 2.1: Key IMF GDP assumptions

	2020	2021[a]	2022[a]	2023[a]
Economic growth[b]				
Advanced economies	-4.5	5.2	4.5	2.2
– Australia	-2.4	3.5	4.1	2.6
– European Union	-5.9	5.1	4.4	2.3
– France	-8.0	6.3	3.9	1.8
– Germany	-4.6	3.1	4.6	1.6
– Japan	-4.6	2.4	3.2	1.4
– New Zealand	-2.1	5.1	3.3	1.7
– South Korea	-0.9	4.3	3.3	2.8
– United Kingdom	-9.8	6.8	5.0	1.9
– United States	-3.4	6.0	5.2	2.2
Emerging economies	-2.1	6.4	5.1	4.6
– ASEAN-5[d]	-3.4	2.9	5.8	6.0
– China[e]	2.3	8.0	5.6	5.3
– India	-7.3	9.5	8.5	6.6
– Latin America	-7.0	6.3	3.0	2.5
– Middle East	3.2	2.8	2.8	2.8
World[c]	-3.1	5.9	4.9	3.6

Notes: a Assumption; b Year-on-year change; **c** Calculated by the IMF using purchasing power parity (PPP) weights for nominal country gross domestic product; **d** Indonesia, Malaysia, the Philippines, Thailand and Vietnam. **e** Excludes Hong Kong.
Sources: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021); IMF (2021)

Table 2.2: Exchange rate and inflation assumptions

	2020	2021[a]	2022[a]	2023[a]
AUD/USD exchange rate	0.69	0.75	0.73	0.75
Inflation rate[b]				
United States	1.2	3.7	3.5	2.7
	2019–20	**2020–21[a]**	**2021–22[a]**	**2022–23[a]**
Australia[e]	1.6	2.4	2.2	2.3

Notes: a Assumption; b Change from previous period; **c** Calculated by the IMF using purchasing power parity (PPP) weights for nominal country gross domestic product; **e** Average of daily rates.
Sources: ABS (2021) Consumer Price Index, 6401.0; Bloomberg (2021); Department of Industry, Science, Energy and Resources; RBA (2021) Reserve Bank of Australia Bulletin; IMF (2021).

Steel

Australian steel refineries

Steel facts

- Made in specialised blast furnaces mostly out of **iron and carbon**
- 1,000 kg of steel requires 1,400 kg of iron and 800kg of coal to make
- Pure steel is **1,000 times stronger** than iron
- Steel is the **world's 2nd largest industry**

World consumption

- **52%** Construction
- **16%** Mechanical machinery
- **12%** Other applications
- **12%** Automotive
- **5%** Other Transport
- **3%** Electrical Equipment

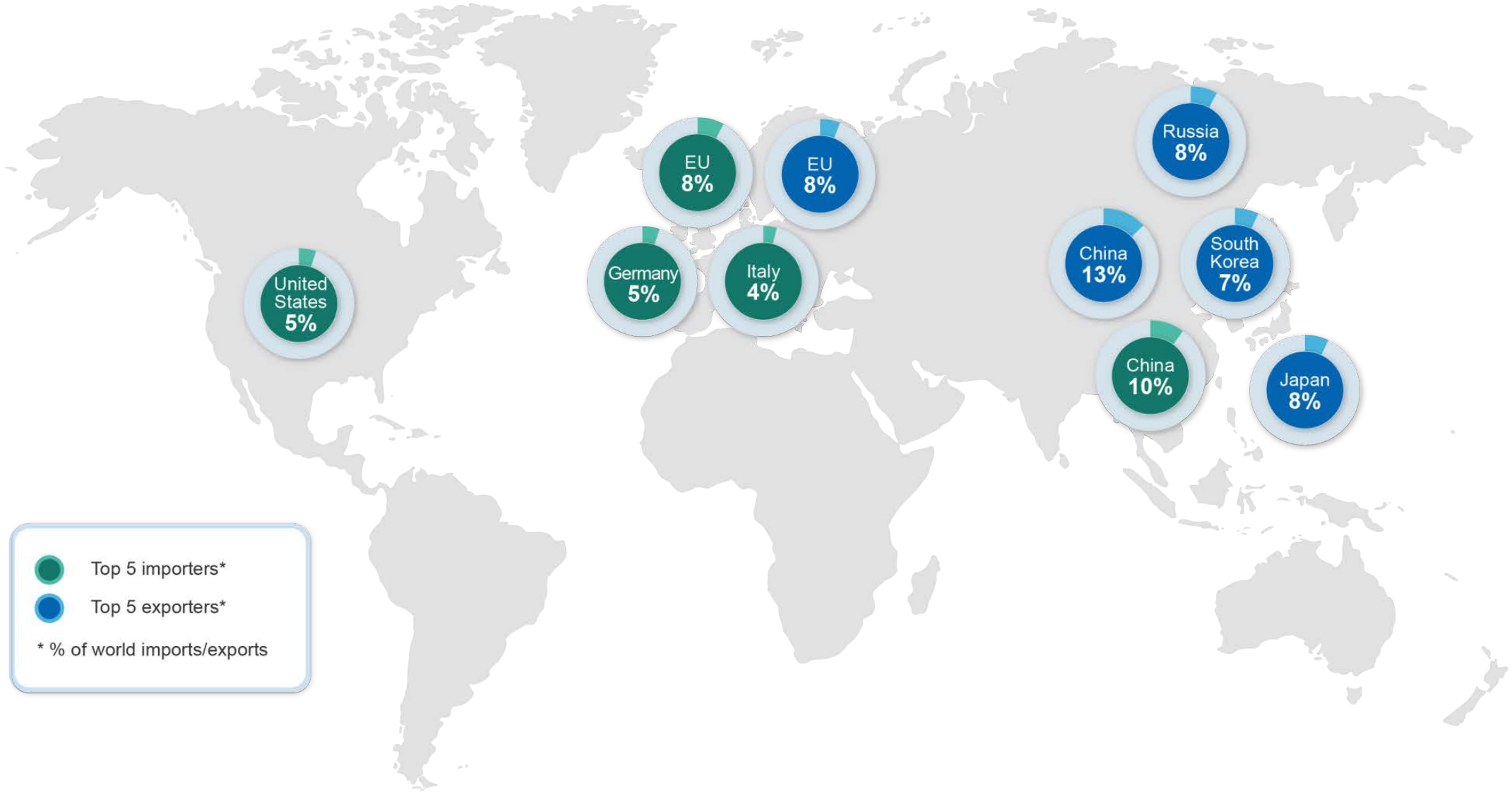
Australia's steel

- **5.3m tonnes produced** each year
- **100,000+ employed** in steelmaking
- **Significant export markets**
  - China
  - Japan
  - South Korea
  - Singapore
  - US

26 Fe 55.845 | 6 C 12.011

Steel

Trade map | December 2021



3.1 Summary

- World demand for steel is estimated to grow by 4.5% in 2021, reflecting the continued recovery in economic activity and industrial output underway in most major economies.
- Lower global steel production in recent months reflects a moderation of economic (and industrial output) growth rates to lower, longer-run trend levels, as well as production cuts and weakened steel demand in China.
- A slower pace for the global recovery from the second half of 2021 is likely to see more moderate growth in steel demand from 2022. New outbreaks of the pandemic and ongoing supply chain issues are downside risks to global growth and steel consumption over the outlook.

3.2 World consumption and production

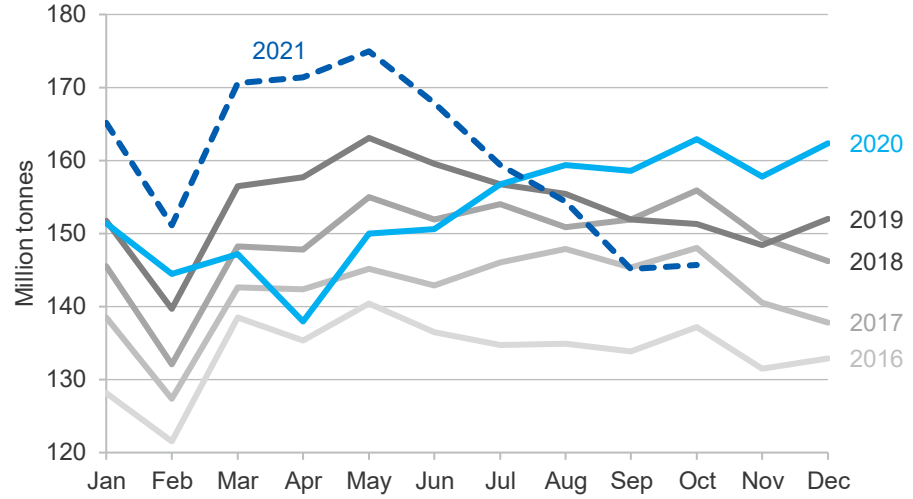
Growth in world steel production slows in the second half of 2021

World steel output in the ten months to October 2021 reached around 1.6 billion tonnes. This was 5.7% higher compared with the same period in 2020, and 4.0% higher than 2019 levels (Figure 3.1).

The strength in world steel production in 2021 reflects the ongoing recovery, as the global economy emerges from the COVID-19 pandemic. Global GDP growth is forecast at 5.9% in 2021. The world's two biggest economies — the US and China — are at the forefront of this resurgence, with forecast growth in 2021 of 6.0% and 8.0%, respectively. The pace of the global recovery is expected to ease to 4.9% in 2022, as pent up demand recedes, and as pandemic-related fiscal and monetary support is withdrawn.

However, the rate of growth in global steel output has slowed considerably in recent months, from a peak of 24% growth year-on-year in May 2021, to a contraction of 10% year-on-year in October. Weaker steel output corresponds with a similar slowdown in global industrial production, which has fallen from a peak of 18% growth year-on-year in April 2021 to 4.1% year-on-year in September (Figure 3.2). This follows an expected return to lower, longer-run growth rates as the global recovery progresses. It also reflects near-term disruptions that have persisted across many global

Figure 3.1: Global monthly steel production



Source: Bloomberg (2021); World Steel Association (2021)

Figure 3.2: World industrial production and steel output

Source: World Steel Association (2021); Bloomberg (2021); CDB (2021); Department of Industry, Science, Energy and Resources (2021)

regions in 2021, due to the pandemic and supply chain issues (see *Macroeconomic Outlook* chapter).

Global steel consumption continues to be propelled by the substantial levels of fiscal stimulus across major economies. This spending has a strong focus on infrastructure and lending support for the global transition to low emissions. This includes the US$1.2 trillion Bipartisan Infrastructure Framework recently signed into law by President Biden (discussed further below), the €750 billion Next Generation EU economic recovery package, as well as the 100 trillion rupee (US$1.3 trillion) infrastructure plan recently announced by India.

World steel production is estimated to reach 1.95 billion tonnes in 2021, representing an expansion of 4.0% compared with 2020. This includes double-digit (or near double-digit) growth for major producers such as the US, EU, India and Japan. However, China — the world's largest steel producer, making up around 55% of global production — is now forecast to see no growth in steel output in 2021.

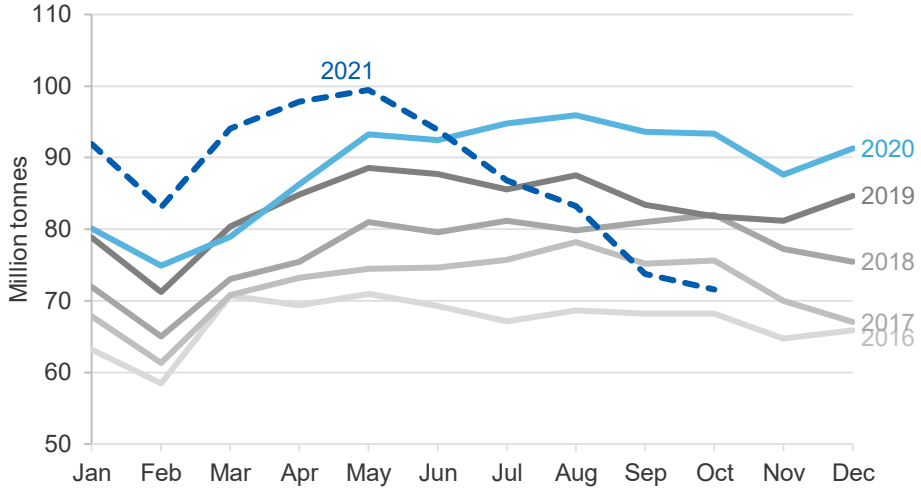
An ongoing risk for global steel markets remains the persistence of global supply chain disruptions and, in particular, the current shortage of global semiconductor chips. Estimates suggest the shortage will lead to as much as 7.7 million fewer vehicles produced in 2021, and cost the automotive industry in excess of $200 billion in lost revenue. With the chip shortages now expected to persist well into 2022, this has significant implications for global steel markets.

China's steel output lower in September quarter on forced production cuts

Following record levels of Chinese steel output in the first half of 2021, October marked five consecutive months of lower output. Total monthly output of about 72 million tonnes in October was 23% lower year-on-year and 12% lower than the same period in 2019 (Figure 3.3).

The fall in output from June this year reflects a significant broadening of emissions-related production curbs by the Chinese Government in the second half of 2021. The curbs — part of country's efforts to reach net

Figure 3.3: China monthly steel production



Source: Bloomberg (2021); World Steel Association (2021)

zero emissions by 2060 and peak steel by 2025 — were initially placed on China's biggest steel-producing city Tangshan in February 2021, with an order for many mills to achieve a 30-50% reduction in output by end 2021.

However, following record steel output nationally through the first half of this year, broader enforcement measures announced in early May required all other provinces (outside of Hebei and its city of Tangshan) to start scaling back production from June. The cuts have seen other major steel-producing provinces — such as Jiangsu, Zhejiang and Anhui — all meet (and in some cases exceed) required cuts by the end of September.

Winter steel curbs are also anticipated from now until the March quarter in 2022. These curbs — which the Chinese Government has said is intended to manage pollution levels, particularly in the northern provinces — will require mills to maintain output below 2020 levels though to December, with some increase then permitted through to March 2022. The curbs have also been widened (from 44 cities in 2020) to 64 cities. The Chinese Government has signalled it is keen to ensure reduced air pollution (and blue skies) for the Beijing Winter Olympics in February 2022.

The recent power supply crunch in China also has had a significant impact on steel production. From the second half of September, a shortage of thermal coal has seen more than half of China's 31 provinces implement power rationing and forced blackouts, severely hampering steel production over the period (see *Thermal coal* chapter). Direct production cuts primarily impacted long steel producers. However, the substantial fall in flat steel prices (for example, hot-rolled coil) demonstrates that indirect impacts — due to reduced industrial production and manufacturing — have been significant.

While there has been some relent in power shortages as of late October, the power crunch will continue to add uncertainty to the outlook for steel production in the near-term, and counter any potential easing of emission-related curbs through to 2022.

China also facing risk of weaker demand for steel over the outlook

The considerable surge in economic activity in China in the first half of 2021 now appears to be easing, creating weaker conditions for major steel users into year end. China's GDP growth, of 4.9% year-on-year in the September quarter 2021, was the slowest in over 12 months.

The major drivers of China's intense demand for steel in the first half of this year — elevated levels of infrastructure and residential property construction, and strong manufacturing activity — have all weakened in recent months, creating headwinds for steel demand in the short term. New investment in infrastructure — used extensively by the government to stimulate the economy out of the pandemic through to mid-2021 — was 5.3% lower (3-month-moving-average) in October compared with the same period in 2020. This follows the central government's continued removal of fiscal stimulus through 2021, as the Chinese economy has emerged from the pandemic (Figure 3.4).

China's policy initiatives to cool its property market also appear to be taking hold. The central government's so-called 'Three Red Lines' policy — introduced in September 2020 — mandates tighter borrowing criteria and reduced debt levels for the country's major property developers.

Figure 3.4: China's total infrastructure investment

Notes: Series is three month moving average
Source: Bloomberg (2021)

This has been bolstered by a cap on new bank lending implemented earlier in the year, leading to weakened investment in real estate in the second half of 2021. New residential property starts in the year to October 2021 were down 6.8% compared with the same period in 2020, and government land sales were 11% lower year-on-year in September. This has also created downward pressure on new home prices, which fell 0.2% month-on-month in October, the first fall since March 2015.

Slowing growth and China's recent power crunch have also severely impacted its manufacturing sector. Growth in industrial production was 3.5% year-on-year in October, down from a high of 14% in March this year. China's steel manufacturing production index (produced by S&P Global Platts) — measuring production data for 17 steel-related manufactured goods — also remained well below levels seen earlier in 2021. This included year-on-year falls for manufactured goods in the construction and consumption sectors, including products such as vehicles, home appliances and excavators.

China's efforts to manage de-leveraging of its residential property sector may face growing challenges as we move into 2022. With weaker economic activity in the September quarter, and renewed outbreaks of the COVID-19 pandemic in October and November, there is a growing market expectation that China's central government may be forced to step in once more to support economic recovery.

The Chinese Government has already announced an intention to lift issuance of local government special bonds, the primary means for government to fund infrastructure. As of September 2021, the issuance of these bonds was running considerably behind the quota (RMB 3.65 trillion or US$570 billion) set for 2021. New projects have already been proposed for provinces such as Shaanxi and Hubei, and more are expected to be announced as the year turns. The flow through of this increased funding is expected to boost new infrastructure and construction activity from early 2022.

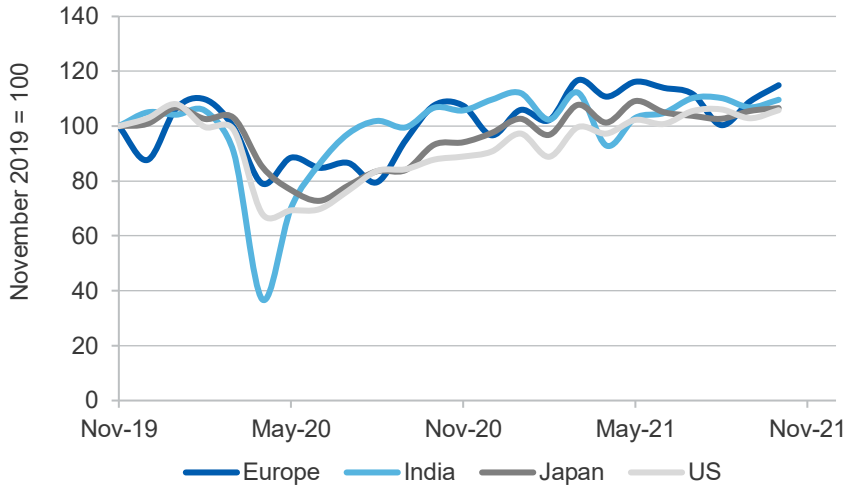
China's central government and People's Bank of China (PBOC) also appear to be taking further steps to manage its residential property sector. This is in light of recent events involving China Evergrande and other private property developers, which have faced funding pressures in recent months. From September, the PBOC has provided a number of rounds of liquidity injections into China's financial system, and regulators have vowed for policies to maintain healthy development of the property market.

For the outlook period, a slowdown of China's residential property market remains a key risk to growth prospects and steel demand. Other risks include new outbreaks of the pandemic, and the resumption of power (and coal) shortages. Steel production is estimated to be fall 1.0% in 2021 to be around 1.05 billion tonnes, before growing 1.3% to reach 1.07 billion tonnes in 2022.

Strong growth in 2021 steel production for other major producers

In spite of ongoing outbreaks of the pandemic and supply chain disruptions, production has remained resilient across other major steel-producing economies in 2021. In the ten months to October, world steel

Figure 3.5: Indexed monthly steel production



Notes: Production has been indexed to November 2019 levels (Nov 2019 = 100)
Source: Bloomberg (2021); World Steel Association (2021)

output (excluding China) grew by 15% year-on-year (and 2.0% compared to 2019 levels) to reach 730 million tonnes.

While steel output (and economic activity) was slower to rebound outside of China, the recovery in many advanced economies remains well underway as 2021 ends. Ex-China steel demand is expected to grow by 9.2% this year, though renewed outbreaks of the pandemic and supply chain disruptions raise significant risks against this outlook.

Steel production in the EU — the second largest steel-producing economy — grew by 24% year-on-year in the ten months to October 2021. This was also 2.0% higher than the same period in 2019.

After a rapid expansion in economic activity across the Europe in the June quarter 2021, the rate of the recovery appears to have slowed in recent months, a consequence of global supply chain disruptions and the shortages this is creating. This is likely to check steel production and demand as the year turns.

Industrial production in the Euro area in September 2021 fell by 0.2% on the previous month, but remained 5.2% higher year-on-year. The Eurozone Manufacturing PMI also marked an eight-month low in October. Business activity in the Eurozone grew at its slowest pace for seven months, with worsening global supply chain disruptions creating long backlogs of orders in factories and widespread shortages of inputs.

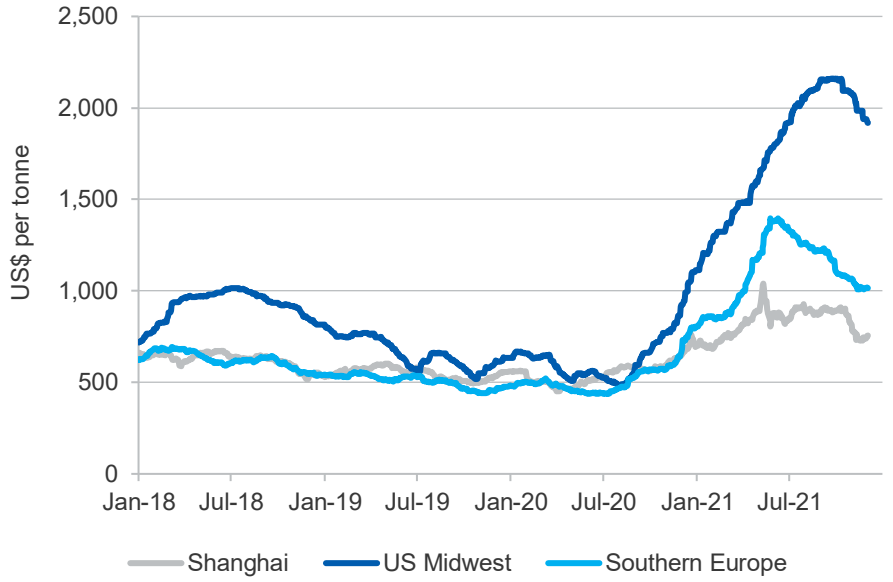
The Euro area continues to be heavily affected by the global semi-conductor shortage. Major automakers such as BMW, Renault and Volkswagen have all been forced to idle production in recent months, on top of output cuts made earlier in 2021. This saw September car sales fall to their lowest levels since the 1990s. Adding to concerns, the industry now expects chip shortages to persist well into 2022.

The EU has announced a number of new initiatives in July as part of its European Green Deal — which aims to reduce net emissions by at least 55% by 2030. This includes the introduction of a carbon border adjustment measure on emissions-intensive goods imported into the EU, such as steel, iron and aluminium. The policy is set to be introduced gradually from 2023, and fully implemented by 2030. The EU is one the world's largest importers of steel, with around 33 million tonnes in 2020 from regions including Asia and Eastern Europe.

US steel production grew by 20% year-on-year in the ten months to October 2021. However, this remained around 2.3% below the same period in 2019. After a rapid pace of recovery in the first half of 2021, growth in the September quarter 2021 has slowed to annualised rate of 2.0%. This follows a new wave of the COVID-19 pandemic from the late summer, and a marked weakening in the level of household consumption.

Strong demand for goods through the first half of 2021 has led to delays and supply bottlenecks for many products, including steel and other construction materials. Idle capacity in US mills, existing tariffs on steel imports, and the ongoing scarcity of scrap steel, have all also contributed to tight supply. While prices for US HRC remain historically high, seasonally weaker demand from late November has seen prices ease off

Figure 3.6: Hot-Rolled Coil steel prices



Source: Platts (2021)

their record highs (Figure 3.6). Prices should be helped by the US and EU agreement in October to end its dispute over the US' 25% tariffs on steel imports from the EU. While the Section 232 tariffs are to remain in place for the time being, limited volumes of EU-produced steel will be permitted into the US duty-free.

The US$1.2 trillion Bipartisan Infrastructure Framework (BIF) was signed into law by President Biden on November 15. This package includes US$550 billion in new federal investment for roads and bridges, rail, and water and electrical infrastructure. The package marks the biggest investment in US infrastructure since the 1950s. Recent estimates from the American Iron and Steel Association suggest that as much as five million tonnes of new demand for steel is created for every $100 billion in new investment, indicating a significant boost to US steel consumption from the new package over the outlook period and beyond.

The global semiconductor shortage that has impacted US automakers throughout 2021 looks set to continue into 2022. As a consequence, many major US auto manufacturers are beginning to investigate internal opportunities to develop chips. The impact of current chip shortages on steel demand and scrap supply remain a risk over the outlook period.

Indian steel output grew by 21% year-on-year in the ten months to October 2021, in spite of widespread COVID-19 outbreaks and related containment measures over the period. While this partly reflects the impacts of a (2020) low base effect — with steel output falling 23% year-on-year in the first half of 2020 — the rebound in the nation's manufacturing and construction industries is ongoing, contributing to rising steel demand.

Following rapid expansion in industrial activity in the first half of 2021, growth in industrial production in October has slowed to 3.1% year-on-year, with weaker production in industries such as mining and quarrying, manufacturing and utilities. This is due to a number of rising supply side issues, including a severe power crunch owing to the shortages of coal, as well as semi-conductor shortages and higher input costs.

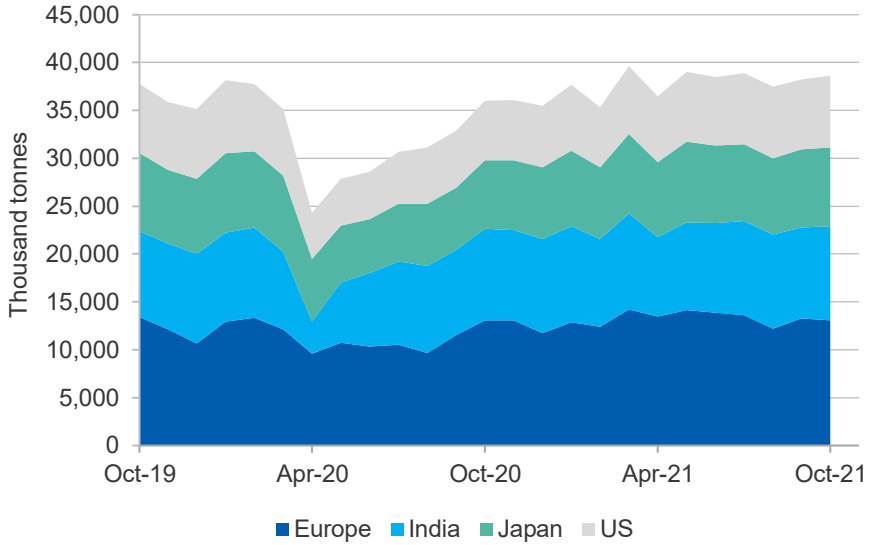
In October, the Indian Government announced a 100 trillion rupee (US$1.3 trillion) integrated infrastructure plan. This plan will aim to boost industrial production and economic growth coming years, and includes a focus on expanding transport infrastructure and the use of cleaner fuels.

Japan's steel production grew by 17% year-on-year in the ten months to October 2021 (Figure 3.5). However, output in the year to October remained around 4.1% below output for the same period in 2019. This follows a fall in total output to its lowest levels in over 50 years during the 2020–21 Japanese fiscal year (April 2020 to March 2021).

Following a severe wave of the COVID-19 pandemic though the summer, Japan's economy contracted by 3.0% year-on-year in the September quarter 2021. Industrial production also fell 2.3% year-on-year in September. This follows slowing growth in machinery orders and exports in recent months. Despite the recent weakness, the business outlook for Japan is positive heading into 2022, as case numbers for the pandemic drop, and mobility restrictions are removed.

New ship export orders in the 10 months to October 2021 were up 138% as global trade continues to make a strong recovery in 2021.

Figure 3.7: Monthly steel production – other major producers



Source: World Steel Association (2021); Department of Industry, Science, Energy and Resources (2021)

Table 3.1: World steel consumption and production

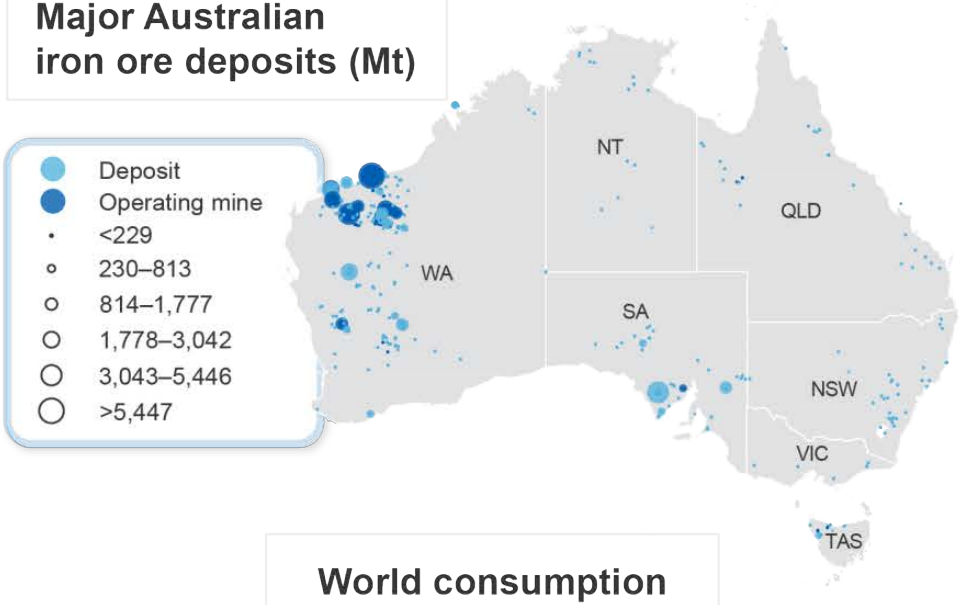
	Million tonnes				Annual percentage change		
Crude steel consumption	**2020**	**2021[e]**	**2022[f]**	**2023[f]**	**2021[e]**	**2022[f]**	**2023[f]**
China	974	967	982	988	-0.6	1.5	0.7
European Union	155	162	163	165	4.5	0.8	1.3
United States	108	115	122	128	6.3	6.2	5.0
India	106	111	117	128	5.4	5.4	9.3
Japan	64	64	65	67	1.4	1.1	2.5
South Korea	52	53	54	55	0.7	2.7	2.5
Russia	45	46	47	48	3.4	1.6	1.4
Brazil	22	23	26	29	4.5	11.3	10.2
World steel consumption	1,883	1,968	2,021	2,072	4.5	2.7	2.5
Crude steel production	**2020**	**2021[f]**	**2022[f]**	**2023[f]**	**2021[f]**	**2022[f]**	**2023[f]**
China	1,065	1,054	1,068	1,074	-1.0	1.3	0.5
European Union	131	143	145	145	9.3	0.7	0.5
India	100	114	125	134	14.0	8.9	7.4
Japan	83	97	99	102	16.0	2.8	2.6
United States	73	86	92	96	17.7	7.5	4.8
Russia	72	76	79	81	6.8	2.8	3.2
South Korea	67	71	75	76	5.5	5.6	1.3
Brazil	31	36	40	44	16.9	11.1	10.1
World steel production	1,878	1,953	2,007	2,059	4.0	2.8	2.6

Notes: **e** Estimate; **f** Forecast.

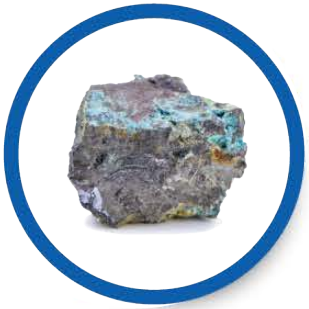
Source: World Steel Association (2021); Department of Industry, Science, Energy and Resources (2021)

26 Fe 55.845 Iron Ore

Major Australian iron ore deposits (Mt)



Iron ore



- Iron is the most abundent element on earth, forming much of the **planet's core**
- Iron ore deposits were originally **formed by algae**
- Humans have been working with iron for at least **5,000 years**
- Iron was central to the **industrial revolution**

World consumption

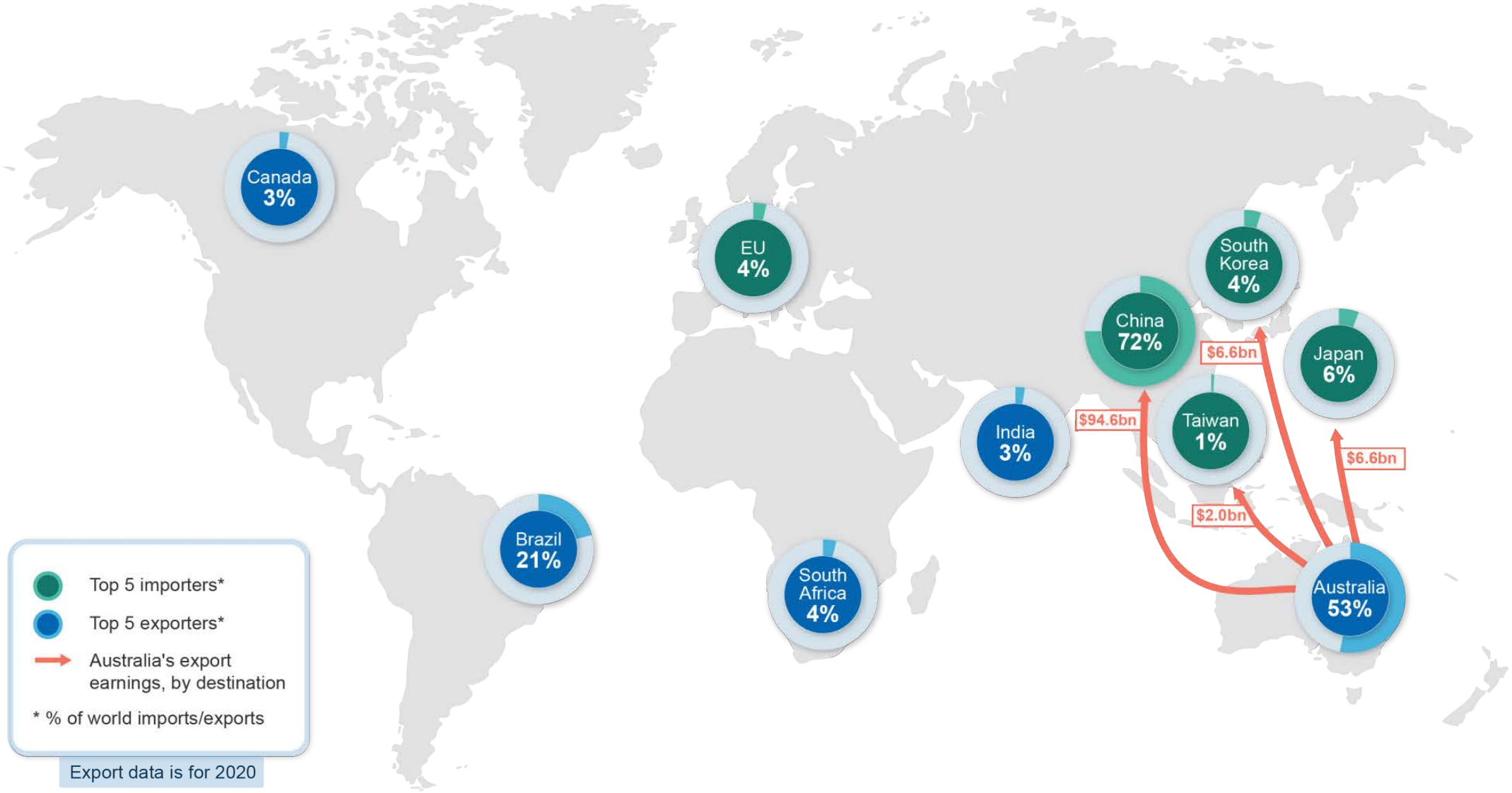
56% China	9% India
5% EU	5% Japan
3% South Korea	22% Rest of the world

Australia's iron ore

- **World's no.1** for iron ore **resources**
- **Largest iron ore producer** in the world
- **Exports** earned **$153 billion** in 2020-2021

26 Fe Iron Ore

Trade map | December 2021



4.1 Summary

- Iron ore prices have fallen to an 18-month low (around US$90 per tonne) as of early December, reflecting forced cuts to Chinese steel production and weaker demand for steel in that nation in the second half of 2021.
- Australian export volumes are expected to grow steadily over the outlook, from 867 million tonnes in 2020–21 to 920 million tonnes by 2022–23. This reflects the commencement of several new mines in Western Australia.
- Iron ore prices are projected to decline further over the outlook period. This is likely to see Australia's iron ore export earnings fall (from $153 billion in 2020–21) to $118 billion in 2021–22, and $85 billion by 2022–23.

4.2 Prices

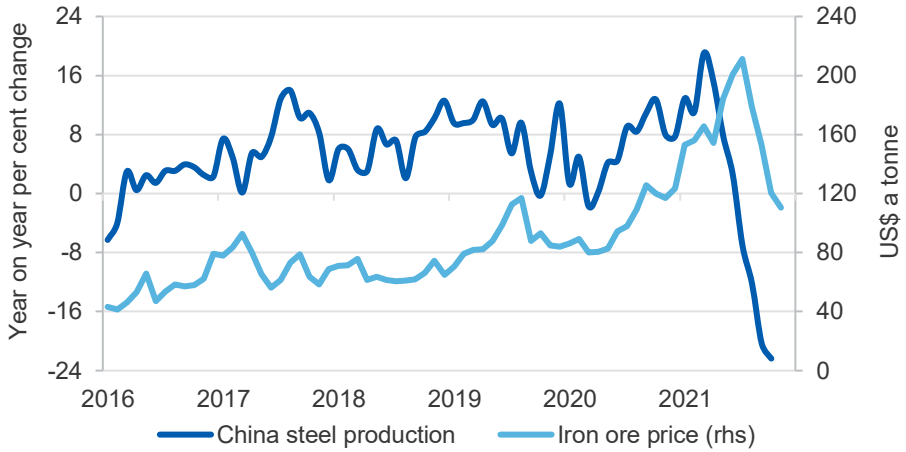
Cuts to China's steel output in Q3 led to big fall in iron ore prices

Following record highs during the first half of 2021, iron ore prices have fallen substantially in recent months, hitting a low of US$85 a tonne by mid-November. The average spot price for 62% Fe iron ore fines at Chinese ports in November was about US$92 per tonne, 60% lower than the peak reached in May 2021, and about 40% lower than at end 2020.

The fall in prices reflects the decline in China's monthly steel production from June 2021 (Figure 4.1). Crude steel output in China for the September quarter 2021 was 16% lower quarter-on-quarter, and 14% lower year-on-year. China's stated goal of no growth in steel output in 2021 now appears on track to be met. Total steel output in the 10 months to October 2021 was 876 million tonnes, 0.9% lower than the same period in 2020. This marks a substantial change from the first half of 2021, when steel output in six months to June was running 11% higher year-on-year.

Lower steel output follows a significant broadening of emissions-related production cuts by China's central government in the second half of 2021 (see *Steel* chapter). This has required all of China's provinces to scale back production to 2020 levels by the end of November — with most on track to meet this goal by the end of the September quarter.

Figure 4.1: Iron ore price and monthly China steel production



Notes: China import Iron ore fines 62% Fe spot (CFR Tianjin port)
Source: Bloomberg (2021) China import prices; World Steel Association (2021)

Steel output has also been adversely impacted by recent power shortages experienced in China (see *Thermal coal* chapter). More than half of China's 31 provinces were required to implement power rationing from September. While direct cuts to steel production were limited, a significant reduction in manufacturing and industrial output saw reduced demand for steel products, particularly flat steel types such as hot-rolled coil.

The combination of emissions-related curbs and elevated coal prices (see *Metallurgical Coal* chapter) has seen the premium for higher grades of iron ore (65% Fe content and above) reach multi year highs (See Figure 4.2). Higher grades typically require less metallurgical coal to be used in the steelmaking process, allowing mills to adjust their input mix to cope with the historically high coal prices seen in recent months. Lower levels of metallurgical coal and fewer ore impurities also lead to reduced emission levels (for a given level of output), allowing mills to maximise output while still adhering to steel production curbs. With China's winter season starting — which typically sees a rise in pollution levels particularly in the north —

emission-related production curbs have been placed on as many as 64 cities place through to March 2022. This may see a persistence of a higher 66% premium through to the March quarter 2022.

China's weaker demand for steel also weighing on iron ore prices

The major drivers of China's elevated demand for steel in the first half of this year — infrastructure and residential property construction, and manufacturing — have all seen weakening activity in recent months. This has created headwinds for steel and iron ore demand in China in the second half of 2021.

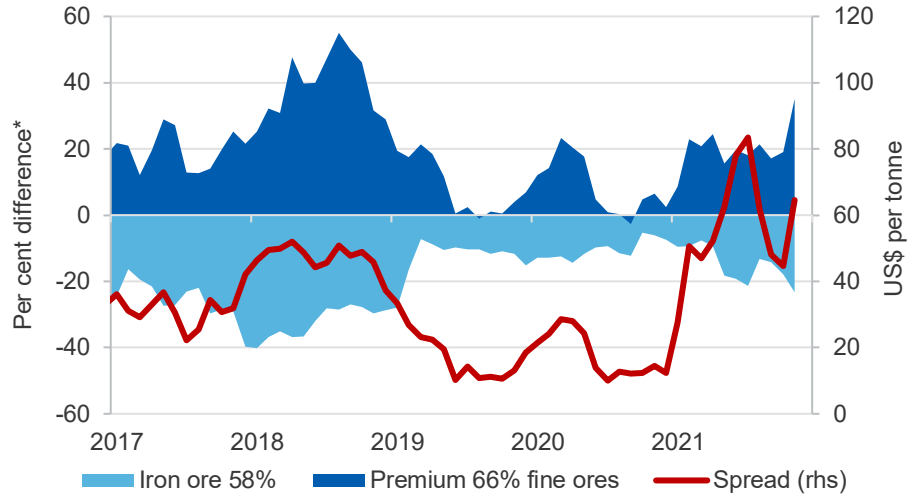
New investment in infrastructure was 5.3% lower (3-month-moving-average) in October compared with the same period in 2020. And new residential property starts in the year to October 2021 were down 6.8% compared with the same period in 2020. The combined impact of these policies weakened the demand for steel from the construction sector in recent months, with this industry typically accounting for 50-60% of domestic steel consumption. This contraction has led to substantial falls in mills' demand for iron ore inputs, particularly from August this year.

China's recent power crunch has also severely impacted its manufacturing sector. Growth in industrial production was 3.5% year-on-year in October, down from a high of 14% in March this year. China's steel manufacturing production index (produced by S&P Global Platts) — measuring production data for 17 steel-related manufactured goods — also remained well below levels seen earlier in 2021.

The falls in steel prices in China over recent months has seen a significant contraction in steel mill profit margins, back to near breakeven levels by the end of the November. Along with government-mandated cuts, this is likely to dampen any incentive for mills to substantially raise steel production levels for the rest of 2021, with many continuing to undertake plant maintenance throughout the second half of 2021.

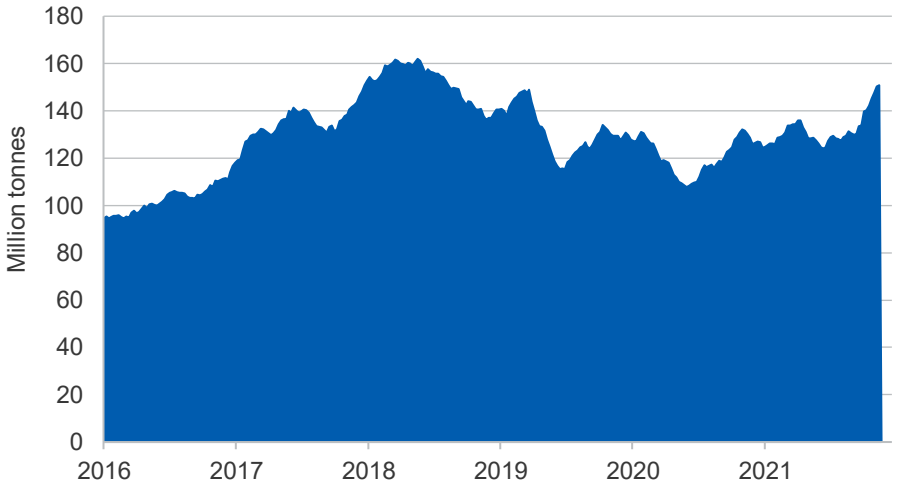
Chinese portside iron ore inventories reached 150 million tonnes at the end of November, well above the five year average and nearing multi year highs (Figure 4.3). This follows the significant drop off in steel production

Figure 4.2: Iron ore price spread between grades



Notes: *Difference to benchmark of 62% iron fines CFR
Source: Bloomberg (2021); China import prices

Figure 4.3: China's weekly iron ore port stocks



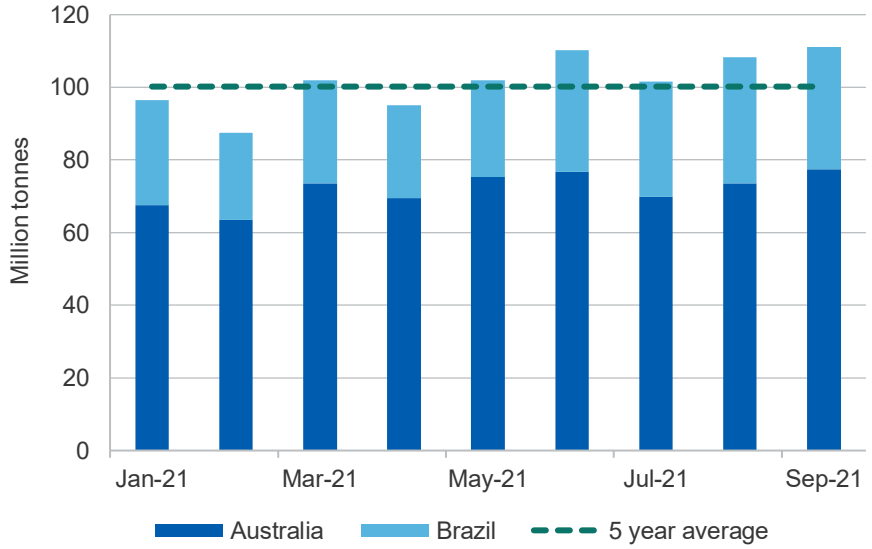
Notes: Benchmark used is 62% iron fines CFR
Source: Bloomberg (2021)

from June, leading to lower portside sales in recent months. The abundance of portside stockpiles provides a significant buffer for steel mills to restock iron ore supply during the December quarter 2021, without causing a significant tightening in the seaborne iron ore market.

Rebound in seaborne iron ore supply in second half of 2021

Export volumes from the world's two biggest producers — Australia and Brazil — have continued to increase in recent months. Combined export volumes have exceeded the five year average since May, and reached their highest ever value in September 2021 at around 111 million tonnes (Figure 4.4). The acute weather disruptions, port maintenance, and safety-related mine closures that contributed to significant supply shortages in both countries in the first half of 2021 appear to have largely resolved. This placed downward pressure on iron ore prices, particularly when considered alongside the present weaknesses in demand in China.

Figure 4.4: Total iron ore exports – Australia and Brazil



Source: ABS (2021); Brazilian customs data

Subdued outlook for iron ore prices for the rest of 2021

With growth in China's steel production now estimated to be flat in 2021 and a growing global iron ore supply, the outlook for iron ore prices remains relatively sombre in the outlook period.

Winter steel curbs for Chinese mills are anticipated to remain until end 2021. These curbs will require mills to maintain output below 2020 levels through to December 2021, with some increase then permitted through to March 2022. The Chinese Government has signalled it is also keen to ensure reduced air pollution (and blue skies) for the Beijing Winter Olympics in February 2022. This is likely to impact major steel-producing provinces close to the capital, such as Hebei, Shandong and Liaoning, and provide a continued dampening effect on iron ore prices through to early 2022.

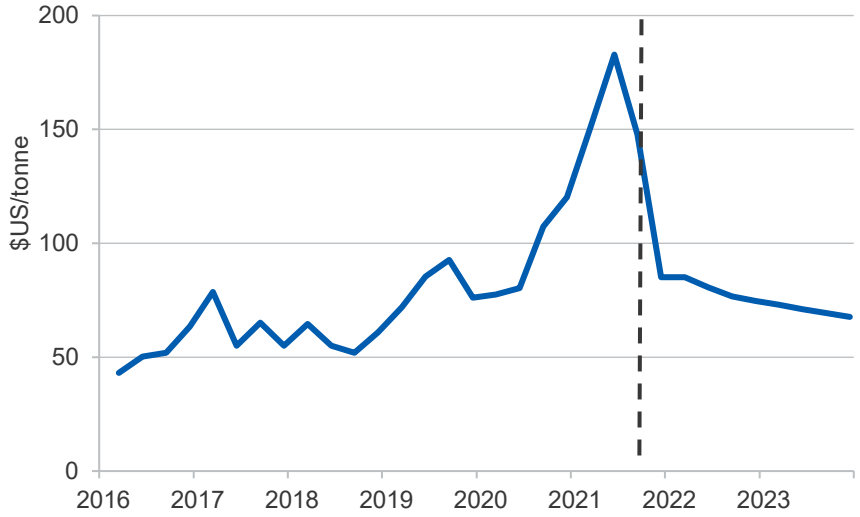
China's efforts to address surging property prices and high debt in its residential property sector also appear to be taking effect, and is expected to lead to lower construction activity going into 2022. With the property construction sector a major end-user of steel (around 30% of China's total demand), continued weakness in this sector has significant implications for iron ore demand over the outlook.

However, China's efforts to de-leverage its residential property sector and remove fiscal stimulus are likely to face growing challenges moving into 2022. This follows weaker economic activity and renewed outbreaks of the COVID-19 pandemic in recent months.

New investment in infrastructure also appears to be picking up in the December quarter 2021. New projects have already been announced for provinces such as Shaanxi and Hubei, and more are expected into year end. The increase in funding is expected to boost new infrastructure activity from early 2022, and raise steel demand for this sector. However, the extent to which this is offset by continued weakness in the residential construction sector is unknown, though it is unlikely construction activity will return to levels seen in the first half of 2021.

After averaging close to US$150 a tonne (62% Fe fines, CFR) in the September quarter, the benchmark iron ore price is forecast to fall to around US$85 a tonne in the December quarter 2021. For the full calendar year, prices are expected to average around US$140 a tonne in 2021, and around US$80 a tonne in 2022 (Figure 4.5).

Figure 4.5: Iron ore price outlook, quarterly



Notes: China import iron ore fines 62% Fe spot (FOB)

Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021)

4.3 World trade

Global iron ore supply improving into the second half of 2021

The sources of tight global supply of iron ore in the first half of 2021 are expected to continue easing as the year turns. Total shipments for the world's four largest iron ore exporters — Australia, Brazil, South Africa and Canada — were estimated to be around 356 million tonnes in the September quarter 2021. This was an increase of 6.5% quarter-on-quarter, and around 13% higher compared with the March quarter 2021, when global seaborne supply shortages were at their most acute.

Australian exports increasing in 2021 in spite of disruptions

Total volumes of iron ore exported from Australia were around 220 million tonnes in the September quarter 2021. While this was flat compared with the June quarter, it was an increase of 7.7% from the weather affected March quarter 2021.

The improvement reflects the recovery in production and exports from Western Australia, following the dissipation of acute weather disruptions seen at the start of 2021. Export volumes have also continued to improve despite ongoing maintenance work at the ports of Dampier and Hedland, as well as pandemic-related delays for major producers in bringing replacement supply online in 2021 (see *Australia* section).

Iron ore shipments from Australia are expected to have continued to rise in the December quarter 2021, as new replacement mine supply comes online for major Australians producers. Total Australian exports are forecast to reach 875 million tonnes in 2021, and over 900 million tonnes in 2022 (Figure 4.6).

Brazilian supply in 2021 continues its recovery from Brumandinho collapse

Total shipments of iron ore from Brazil — the world's second largest exporter behind Australia — reached around 100 million tonnes in the September quarter 2021. While this was 16% higher quarter-on-quarter, it remained around 3.1% lower than the same period in 2020.

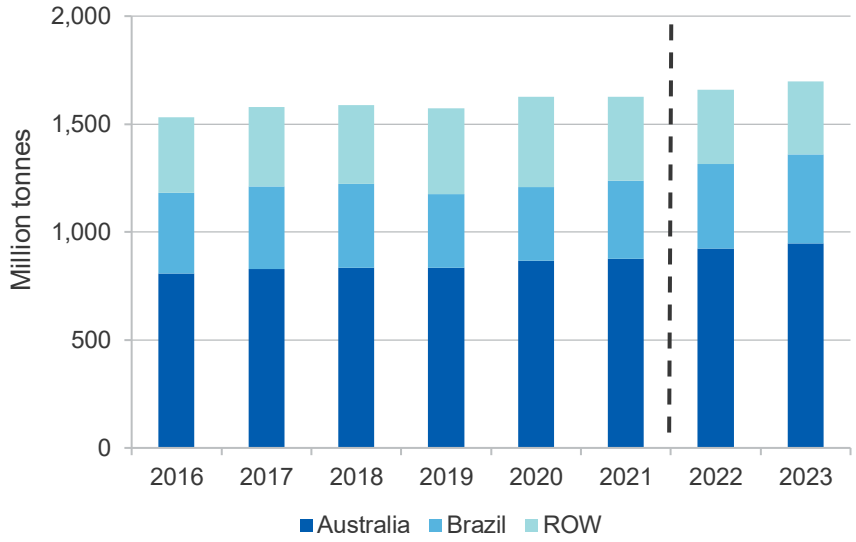
Brazil's largest producer, Vale, had total production of 89 million tonnes in the September quarter 2021, an increase of 18% compared with the previous quarter (and a 0.8% increase year-on-year). This followed an improvement in seasonal weather conditions, an increase in production capacity at its Vargem Grande Complex, and the resumption of iron ore pellet operations at its Fábrica site. Despite the improvement Vale's September 2021 production update set full year 2021 production guidance of between 315–335 million tonnes, and indicated it was likely to be at the lower end of this range. In late November, 2021 guidance was further updated to between 315-320 million tonnes.

The company also outlined a new strategy aimed at prioritising value over volume, and lowering supply of some of its high-silica, low margin product. This is expected to lead to lower production of around 4 million tonnes in 2021 and 12-15 million tonnes in 2022.

In September 2021, Vale cut its targeted production capacity for 2022 (from 400) to 370 million tonnes, primarily due to delays in permitting at its Serra Norte complex in the Northern System. The planned growth in capacity in 2022 remains contingent on recommissioning and expansion of its Southeastern and Northern systems, with output capacity from its Serra Sul mine rising from 83 million tonnes in 2020 to 100 million tonnes from the second half of 2022.

Total Brazilian exports are forecast to reach 362 million tonnes in 2021, over 390 million tonnes in 2022 and 412 million tonnes in 2023 (Figure 4.6).

Figure 4.6: Outlook for global iron ore exports



Source: World Steel Association (2021); Department of Industry, Science, Energy and Resources (2021)

China's iron ore imports higher in Q3, but reflecting weaker demand

China's total imports of iron ore in the September quarter 2021 were around 281 million tonnes. While this was an increase of around 1.4% quarter-on-quarter, the result was around 12% lower than the same period in 2020, reflecting the weakened demand for iron ore in China so far in the second half of 2021.

The severe congestion at Chinese ports in the September quarter 2021 — due to renewed outbreaks of the pandemic and stricter COVID-19 protocols — appears to have receded in more recent months. However, the number of bulk carriers waiting to unload remains elevated, particularly in northern ports. While this does not appear to have materially impacted iron ore prices in the period, port congestion remains a risk.

The seaborne iron ore market is expected to remain relatively tight over the outlook period, and remains susceptible to supply disruptions.

Longer term iron ore projects in Africa continuing to be developed

In May 2021, the Chinese Government announced an aim to diversify its current iron ore supply. Australia currently accounts for more than 60% of the nation's iron ore imports. The Chinese Government's new plan included a target of 45% self-sufficiency in steelmaking raw materials by 2025; increased domestic exploration and output of iron ore; and securing more overseas reserves.

As part of this, China is investigating a number of possible iron ore mines in Africa, including large deposits in Gabon and Madagascar. The most notable prospect in Africa is the proposed Simandou iron ore mine, located in Guinea. The project has been increasingly emphasised as a key element in China's future supply chains, although production remains a number of years away. With potential full production capacity of 200 million tonnes per year, this is around 15-20% of output currently produced in the Pilbara region of Western Australia.

However, there are significant risks for this project to be brought into development. The project requires long term and significant investment in mining-related and transport infrastructure to get minerals to market,

including development of a new port and 650 kilometres of new railway. And in September, a coup against President Alpha Condé demonstrated how exposed the project is to political instability in the country.

Elsewhere in Africa, the Ikongwe mine in Botswana achieved its maiden export of iron ore, with output reaching China in September. The mine is owned by Vision Ridge Investments — a unit of India's Yashomann Industries — and has an order to provide 50,000 tonnes per month (0.6Mt a year) to a state-owned steel producer in China. The project is aiming to produce one million tonnes of iron ore per year.

Global iron ore markets are expected to remain tight, with slow growth in both supply and demand over the next few years. Market structure is not expected to alter significantly, with Australia's market share expected to hold up. A recovery in Brazilian supply is likely in the short-term, but a number of high-cost mines in Brazil and China are also expected to face closure or depletion over the next 10 years.

4.4 Australia

Iron ore export earnings moderate from record set in June quarter 2021

Australia's total iron ore export value reached $43 billion in the September quarter 2021. This was about $6.0 billion (or 12%) lower quarter-on-quarter, reflecting the significant fall in iron ore prices from August 2021. However, the result remains around $13 billion (or 45%) higher than the same period in 2020.

Total volumes of iron ore exported from Australia in the September quarter 2021 (about 220 million tonnes) were flat compared with previous quarter and about 1.1% higher than the same period in 2020. This follows recent maintenance work undertaken at Port Hedland, and pandemic-related delays in bringing replacement supply online in 2021 by major producers.

Iron ore exports to China totalled around $35 billion in the September quarter 2021, representing around 82% of total Australian iron ore export value. Total export value to China fell close to 13% quarter-on-quarter, however remained 49% higher than the same period in 2020. The outcome reflects the significant tailwind elevated iron ore prices provided for Australian exporters through to August this year, with export volumes to China in the September quarter 2021 only about 6.9% higher year-on-year.

Despite modest falls in export volumes for a number of Australia's major producers in the March quarter 2021, domestic operations continued to perform strongly in 2021. Total export volumes of iron ore are projected to reach 874 million tonnes in 2021, up 0.8% year-on-year.

Rio Tinto shipped 83 million tonnes in the September quarter 2021, a 9% rise quarter-on-quarter and 2% higher than the same period in 2020. However, shipments for nine months to September 2021 remained 2% below where they were for the same period in 2020, reflecting the severity of seasonal weather disruptions experienced through the first half of 2021, and some difficulties in bringing its significantly-sized replacement capacity online. Rio Tinto has now revised 2021 output guidance down (from 325–340 million tonnes to 320–325 million tonnes), following modest delays in completing development of its Gudai Darri and Robe Valley projects.

Rio Tinto is aiming to bring around 90 million tonnes of replacement mine capacity online in 2021. Rio Tinto's brownfield mine replacement project at West Angelas (30 million tonnes per annum capacity) has now been commissioned, while first ore was achieved at its Robe Valley project (25 million tonnes per annum) in August. The company's third brownfield replacement project, Western Turner Syncline Phase 2 (32 million tonnes per annum) is still expected to produce its first ore in 2021, while its new Gudai Darri project (43 million tonnes per annum) is projected to start producing from the March quarter 2022.

BHP's total iron ore production was 63 million tonnes in the September quarter 2021. This was a fall of 3% quarter-on-quarter and 4% lower year-on-year. This reflected major maintenance during the quarter at Port Hedland, as well as temporary rail labour shortages related to COVID-19 border restrictions. BHP has retained 2021–22 guidance at 249–259 million tonnes, and this will include a ramp up of its South Flank project, which achieved first ore in May 2021, and is expected to reach full production of 80 million tonnes per year over the next few years. In

September 2021, BHP also received regulatory approval to lift capacity at its Port Hedland operations (from 290 million tonnes per annum) to 330 million tonnes per annum. This development will follow debottlenecking work planned for the December quarter 2021.

Fortescue's total iron ore exports were around 46 million tonnes in the September quarter 2021. While this was a fall of 8% on shipments made in the June quarter 2021, it remained 3% higher compared with the same period in 2020 and a new record for the September quarter. This has come as Fortescue's newly developed Eliwana project ramps up, with output expected to reach almost 30 million tonnes per year. Fortescue is continuing to develop its 22 million tonne per annum Iron Bridge Magnetite Project, with first output scheduled for December 2022. This new project will deliver high grade 67% Fe magnetite concentrate.

With steady production volumes and record prices, Australia's iron ore export earnings reached a new record of $153 billion in 2020–21. Prices for iron ore are expected to continue to ease from the second half of 2021, leading to some moderation in earnings over the subsequent two years. Total export value for iron ore is forecast to be $118 billion in 2021–22 and $85 billion in 2022–23 (Figure 4.7).

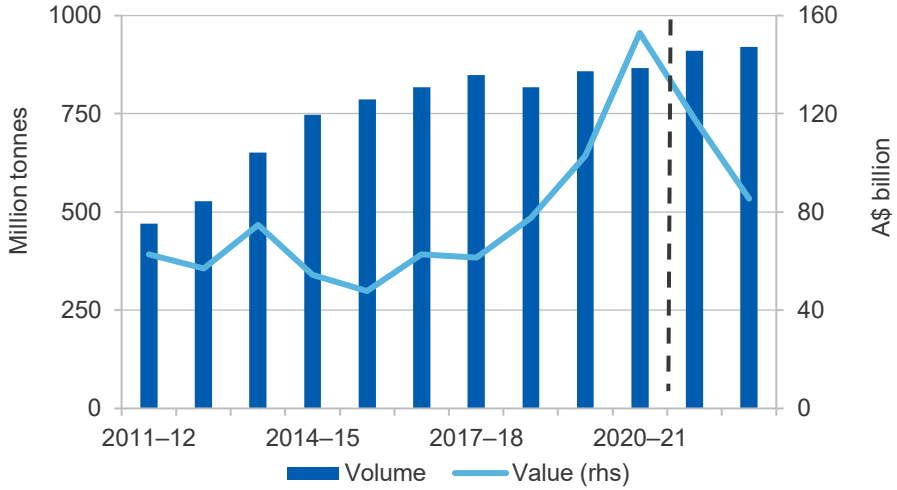
Iron ore exploration expenditure is growing as prices lift

A total of $175 million was spent on iron ore exploration in the September quarter 2021. This is 16% higher than exploration in the June quarter 2021, and 57% higher than the same quarter in 2020. Exploration has been elevated in recent quarters as iron ore prices have reached historical highs in the first half of 2021 (Figure 4.8).

Revisions

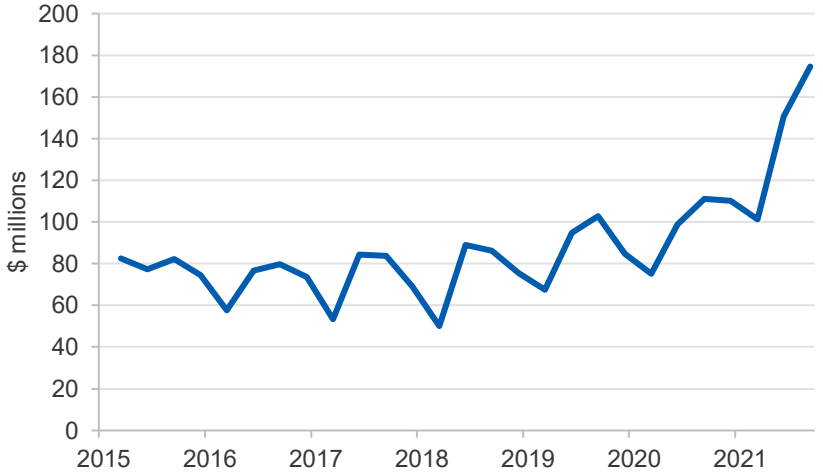
Forecast export earnings for 2021–22 have been revised downwards from $132 billion in the September 2021 *Resources and Energy Quarterly* (in nominal terms) to $118 billion in this edition. This reflects the substantial fall in prices from August 2021. Forecast Australian export earnings have been revised down (by around $14 billion) for 2022–23 to $85 billion, reflecting falling prices from the second half of 2021.

Figure 4.7: Australia's iron ore export volumes and values



Source: ABS (2021) International Trade, Australia, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Figure 4.8: Australian iron ore exploration expenditure, $m



Source: ABS (2021) Mineral and Petroleum Exploration, Catalogue 8412

Table 4.1: World trade in iron ore

	Million tonnes				Annual percentage change		
	2020	2021[s]	2022[f]	2023[f]	2021[s]	2022[f]	2023[f]
Total world trade	1,626	1,581	1,619	1,652	-2.8	2.4	2.0
Iron ore imports							
China	1,170	1,131	1,161	1,175	-3.4	2.7	1.2
Japan	99	119	122	125	19.6	2.8	2.6
South Korea	70	73	77	78	4.2	5.6	1.2
European Union	63	78	78	78	23.6	0.0	0.0
Iron ore exports							
Australia	867	874	923	948	0.8	5.5	2.8
Brazil	342	362	394	412	5.9	8.9	4.6
South Africa	66	69	69	73	5.1	0.7	5.1
Canada	55	54	55	57	-2.6	2.4	3.7
India	52	37	38	37	-29.4	3.9	-3.6

Notes: **f** forecast; **s** estimate

Source: World Steel Association (2021); International Trade Centre (2021); Department of Industry, Science, Energy and Resources (2021)

Table 4.2: Iron ore outlook

						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021[s]**	**2022[f]**	**2023[f]**
Prices [bc]								
– nominal	US$/t	96	142	79	70	47.0	-44.0	-11.4
– real [d]	US$/t	100	142	77	66	41.8	-45.9	-13.7
Australia	**Unit**	**2019–20**	**2020–21[s]**	**2021–22[f]**	**2022–23[f]**	**2020–21[s]**	**2021–22[f]**	**2022–23[f]**
Production								
– Steel [h]	Mt	5.48	5.67	5.94	5.97	3.5	4.9	0.5
– Iron ore	Mt	911	921	949	954	1.1	3.0	0.5
Exports								
Steel [h]	Mt	0.88	0.78	0.92	1.03	-11.6	18.0	12.1
– nominal value	A$m	1,011	772	892	931	-23.6	15.5	4.4
– real value [i]	A$m	1,052	791	885	908	-24.8	11.9	2.6
Iron ore	Mt	858	867	911	920	1.1	5.0	1.0
– nominal value	A$m	102,861	152,970	117,700	85,318	48.7	-23.1	-27.5
– real value [i]	A$m	107,131	156,460	117,806	83,533	46.0	-24.7	-29.1

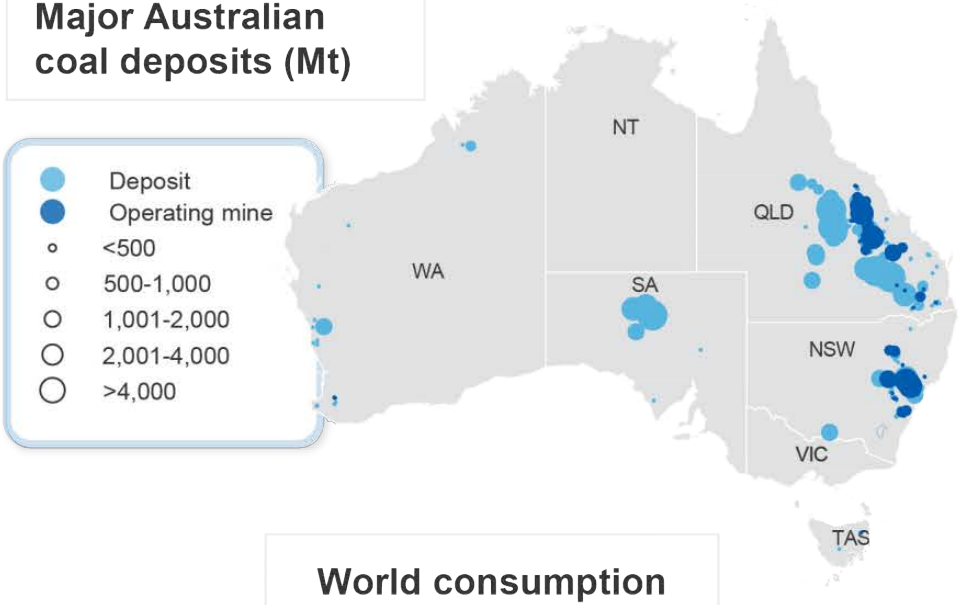
Notes: **b** fob Australian basis; **c** Spot price, 62% iron content basis; **d** In 2021 US dollars; **e** In 2021–22 Australian dollars; **f** forecast; **h** Crude steel equivalent; Crude steel is defined as the first solid state of production after melting. In ABS Australian Harmonized Export Commodity Classification, crude steel equivalent includes most items from 7206 to 7307, excluding ferrous waste and scrap and ferroalloys; **s** estimate.

Source: ABS (2021) International Trade in Goods and Services, Australia, 5368.0; Bloomberg (2021) Metal Bulletin; World Steel Association (2021); AME Group (2021); Company Reports; Department of Industry, Science, Energy and Resources (2021)

Metallurgical coal

6 C Carbon 12.011

Major Australian coal deposits (Mt)



Metallurgical coal

- Metallurgical coal is primarily used **to make steel**
- Contains **more carbon and less ash & moisture** than thermal coal
- 1x tonne of steel made in a blast furnace **uses 780kg of met coal**
- Electric arc furnaces don't use met coal as a **raw material**

World consumption

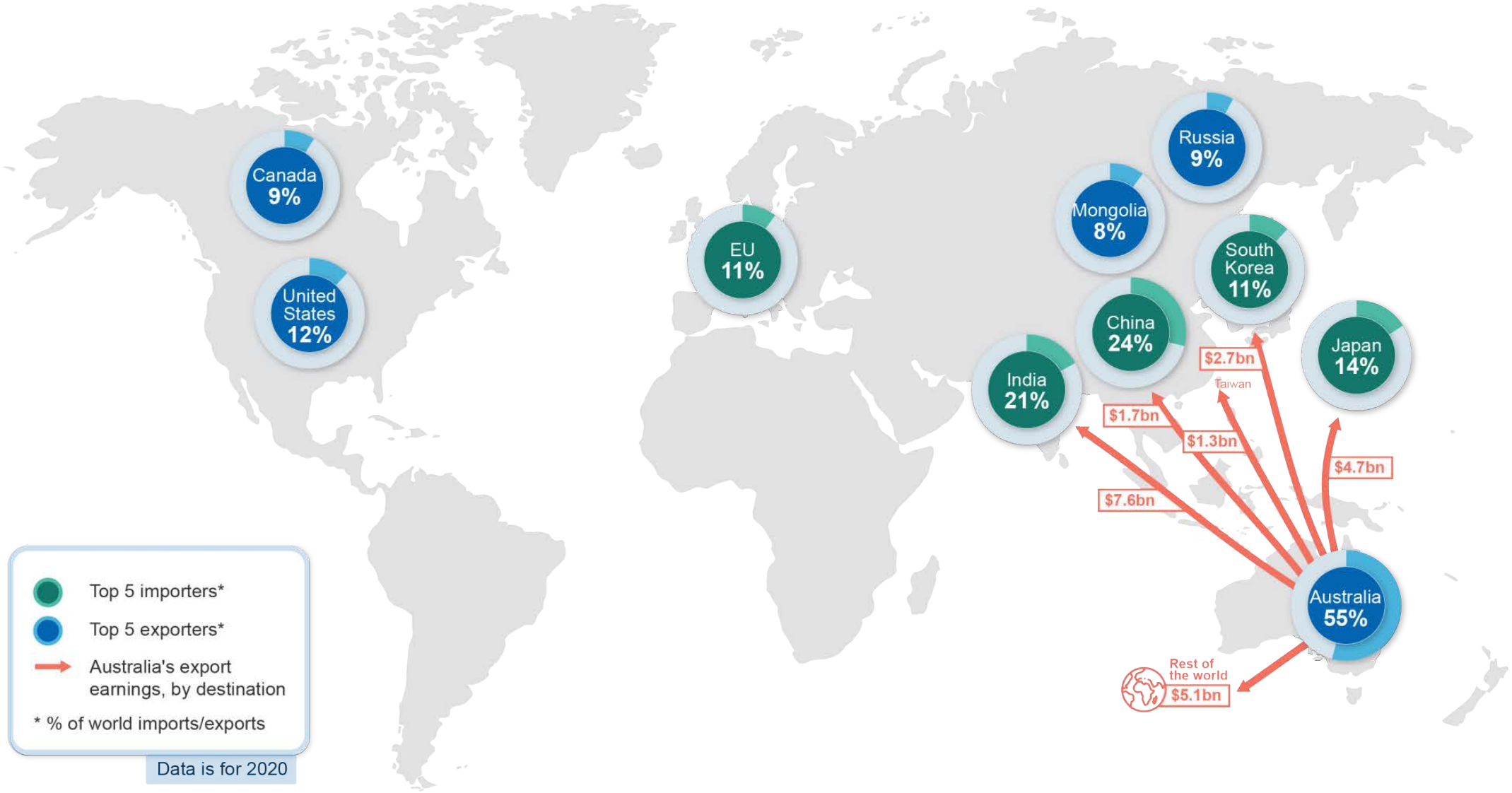
- **59%** China
- **10%** India
- **7%** Russia
- **5%** EU28
- **5%** Japan
- **4%** South Korea

Australia's metallurgical coal

- **World's no.1** **metallurgical coal** exporter
- **170m tonnes** of **metallurgical coal** exported each year
- **Almost all** of Australia's met coal is **exported**

Metallurgical coal

Trade map | December 2021



5.1 Summary

- Metallurgical coal prices have held at historic highs for several months, as supply shortages have met strong Chinese demand and rebounding global industrial production. The Australian premium hard coking coal (HCC) price is forecast to ease from an average US$227 a tonne in 2021 to still-high US$162 a tonne by 2023.
- Australia's exports are forecast to rise from 171 million tonnes in 2020–21 to 181 million tonnes by 2022–23. Supply chains disrupted by China's informal import restrictions have largely reorganised (see *Australia section*).
- Australia's metallurgical coal export values are forecast to surge with recent price movements, rebounding from $23 billion in 2020–21 to peak above $50 billion in 2021–22, before easing to $37 billion in 2022–23.

5.2 World trade

Strong global demand and tight supply drove metallurgical coal prices to extremely high levels in late September, and these prices have persisted for more than two months. Prices for virtually all grades have more than doubled in through-the-year terms. China's informal import restrictions on Australian exports have obliged the country's steel mils to draw in supply from virtually all non-Australian sources. India, Japan, South Korea and the EU have all switched to Australian-sourced imports in response. The price differential which affected Australian suppliers in the immediate aftermath of the Chinese import restrictions has reduced, with prices now at historical highs for Australian metallurgical coal.

Supply and demand are expected to come into better balance over the outlook period, as supply disruptions pass. Supply growth is expected from Canada, the US, Australia and Mongolia. BHP, which owns mines in multiple countries, has released guidance suggesting that its output across the board could rise significantly in 2022.

This rebalance may happen more swiftly in the event that Chinese policy or economic factors change in the months ahead (see *China* section). However, risks also remain in the other direction, with China still short of coal and likely to seek higher imports in 2022. As much of the new supply expected in 2022 is likely to come from Australia, Chinese demand will need to bring in an even greater share of ex-Australian coal than now, resulting in potential for price breakouts and further supply chain disruptions. Freight prices may also rise as a result of the greater distances which coal redirected to alternative markets might need to travel.

Globally, consumer spending and industrial activity are expected to remain strong, ensuring generally solid conditions for metallurgical coal even under pessimistic scenarios. However, the worsening shortage of semiconductors presents risks to this growth outlook, potentially disrupting or halting large swaths of automotive and consumer goods manufacturing. Impacts on these sectors could easily spread to global steelmaking chains, potentially reducing metallurgical coal use sharply.

On balance, metallurgical coal trade is forecast to increase from 320 million tonnes in 2020 to 344 million tonnes in 2023, matching the previous peak recorded in 2018. Supply is expected to grow steadily, while demand remains strong, albeit with downside risks.

5.3 World imports

Chinese steel demand is easing, and remains subject to downside risks

Metallurgical coal prices in China have surged, due to a combination of strong domestic steel demand, constrained global supply, and informal import restrictions against Australian supply. This has led to domestic coking coal prices reaching new highs in October, when premium coal topped US$600 a tonne.

The Chinese Government has moved to curb steel production in response. Steel mills in Hebei, Shandong and Tianjin will be obliged to cut their output in the December quarter, and the Government has flagged a potential further cut early in the March quarter of 2022, prior to the Beijing Winter Olympics. Mandated output cuts are set to land heaviest on carbon-intensive producers, with authorities providing leeway for low-carbon mills and electric arc furnaces (which use recycled steel scrap) to hold output at current levels for the time being.

Steel output in China may also slow in line with industrial production and GDP growth, which are both softening. Rapid growth in real estate investment (which topped 10% over the year to August) also appears now to be easing as regulatory measures intended to slow the flow of resources to the property sector take effect. Construction accounts for around half of China's domestic steel use, but has faced difficulties in the wake of the Evergrande debt crisis, which led to increasing concerns that many Chinese real estate companies could hold unsustainable levels of debt. These risks to steel demand (see *Steel chapter*) also represent a sizeable risk for metallurgical coal demand and prices.

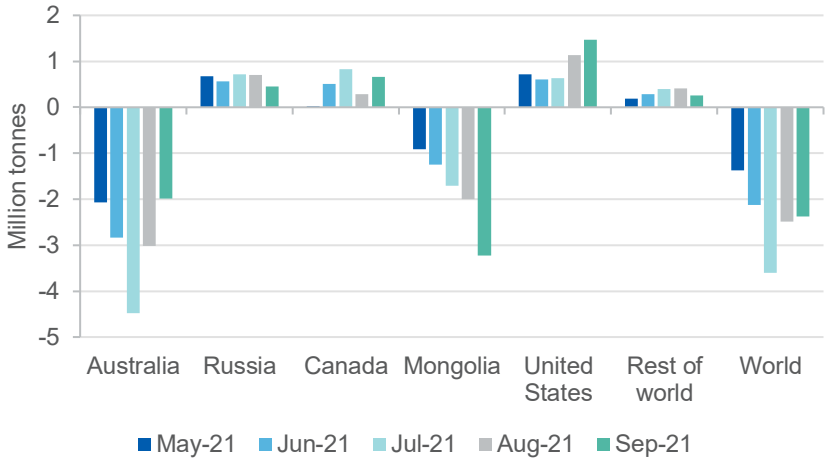
On balance, it is estimated that Chinese metallurgical coal imports have dropped significantly in 2021 (Figure 5.1), with a partial recovery expected in 2022. Imports are not expected to reach pre-COVID-19 levels during the outlook period.

India's metallurgical coal imports are recovering

Indian steel output has risen significantly in the second half of 2021, but the growing shortage of metallurgical coal supply may hamper further growth. Australia accounted for around three-quarters of metallurgical coal imports to India over the year to September, while import shares for Canada and the US declined to 3% and 5% over the same time period, reflecting their redirection to China. This creates added risk that any weather or shipping disruptions from Australia could affect Indian steelmaking in particular, and lead to seaborne prices spiking further.

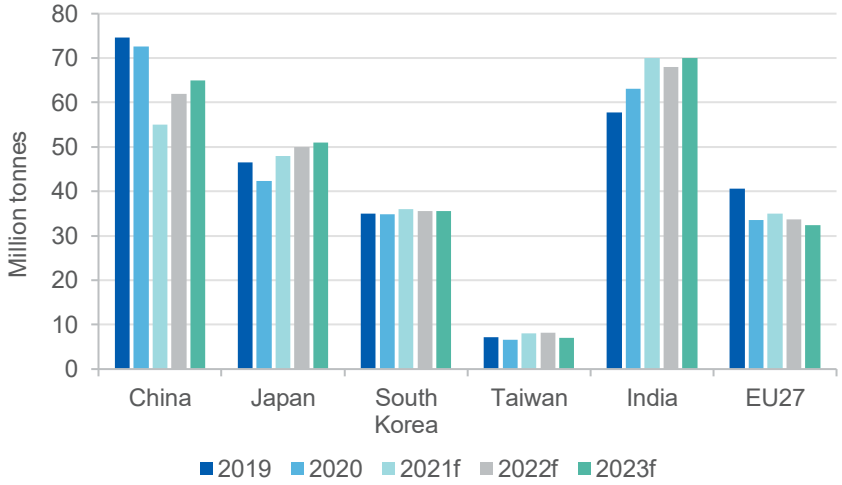
India's metallurgical coal needs are likely to grow in subsequent years. Indian steelmakers have announced projects worth a total of US$11 billion over the next five years (though final investment decisions are yet to be made in many cases). Recent growth in imports is likely to continue, given the pressure to expand steel output. Imports are estimated to have risen strongly in 2021 (bringing India ahead of China), but are forecast to edge back in 2022 as capacity limits are reached and supply constraints on metallurgical coal persist. However, further growth is expected in 2023, as more supply becomes available (Figure 5.2).

Figure 5.1: China's metallurgical coal imports, year-on-year change



Notes: China customs released combined January/February data for 2021.
Source: Bloomberg (2021); China customs (2021)

Figure 5.2: Metallurgical coal imports



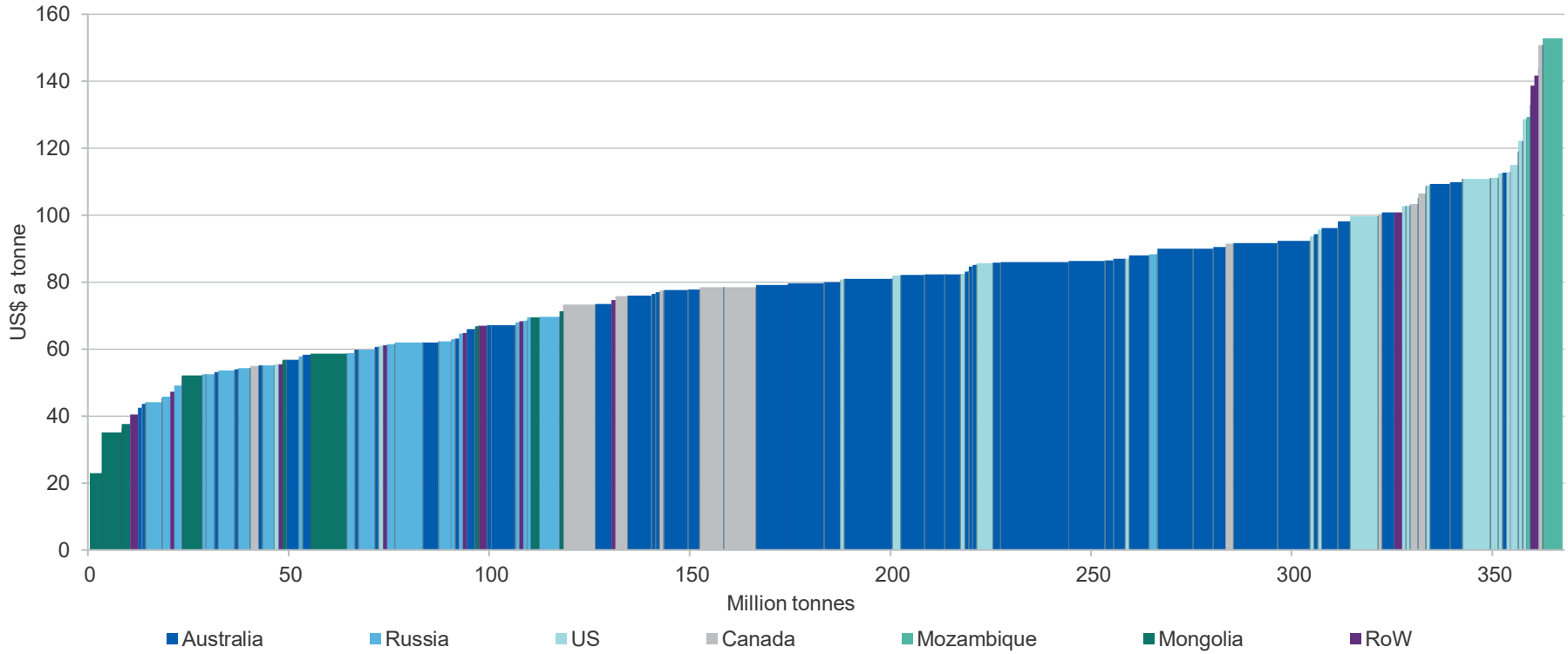
Notes: **f** Forecast..Source: IHS (2021); Department of Industry, Science, Energy and Resources (2021)

Japanese and South Korean imports are picking up faster

An accelerating economic recovery and successful containment of the COVID-19 outbreak in Japan has provided a solid basis for a rebound in Japanese steelmaking. Manufacturing conditions and consumer goods sales are also rising, but risks remain: most notably, the semiconductor shortage, which risks creating severe difficulties for the manufacturing sector in Japan. Subject to this risk, it is expected that steelmaking will grow solidly in 2022 after a strong 2021, leading to a rise in Japanese metallurgical coal imports from 42 million tonnes in 2020 to 51 million tonnes by 2023.

South Korea, where steelmaking was relatively less affected by the COVID-19 pandemic, has also largely recovered, with imports expected to edge up slightly to 36 million tonnes by 2023.

Figure 5.3: Metallurgical coal (including hard coking, PCI and semi-soft) global cost curve, FOB



Notes: FOB is Free on Board. RoW is rest of world.

Source: AME Group (2021); Department of Industry, Science, Energy and Resources (2021)

5.4 World exports

US producers are slowly responding to favourable price movements

US supply has been largely stagnant through much of 2021, with some mines affected by labour shortages and disputes (Figure 5.3). This is despite huge growth in prices brought about by strong global steel demand and informal import restrictions imposed by China on Australia, which have led Chinese steelmakers to seek coal elsewhere.

There are prospects for some belated supply responses to the conditions of recent months. A labour strike at Peabody's Shoal Creek mine in the US is ongoing at the time of writing, but resolution would likely bring 2 million tonnes per annum of metallurgical coal supply back to the market. Ben's Creek Group, which owns the closed-down HVA/HVB project in West Virginia, has announced that the mine will restart before the end of 2021, producing around 450,000 tonnes annually by the mid-2020s.

US supply remains subject to high production costs and high transport costs to Asia. The recent surge of prices should support strong profitability for firms able to grow their output, though there are few signs of significant growth thus far (Figure 5.4).

Russia's exports are recovering, supported by new infrastructure

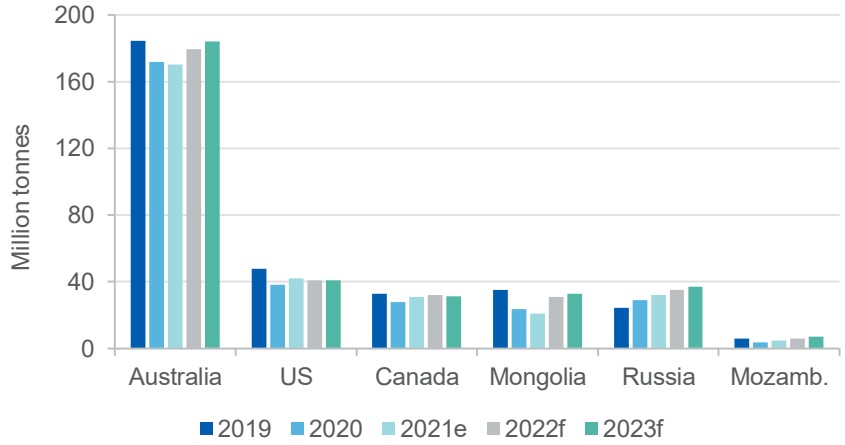
Russian exports edged off slightly in the September quarter, affected by longwall relocations and persistent bottlenecks and rail capacity constraints in Siberia. A large quantity of rail capacity is currently under review or under development, with significant new capacity expected to come online between 2022 and 2024. A new proposal by A-Property for a private rail line to Russia's east coast would further supplement existing rail facilities, though the Russian Government has yet to approve it.

With maintenance largely completed and infrastructure bottlenecks set to ease, Russian exports are expected to recover from a 2020 low of 30 million tonnes to reach 37 million tonnes by 2023 (Figure 5.4). Russian coal is highly suited to markets in northern Asia, being cheap to produce and unusually low in sulphur — a distinct benefit in markets where pollution laws are becoming more stringent.

Mongolia's exports are rising, supported by Chinese demand

Mongolian exports have partially recovered from a sharp fall during 2020, when trade was disrupted by Chinese efforts to contain the COVID-19 pandemic. Exports are expected to increase over the outlook period, from 24 million tonnes in 2020 to 33 million tonnes by 2023. These exports should help to ease pressure in the Chinese domestic market, potentially reducing broader pressure on global seaborne trade in the process. However, some risks remain the form of China's zero-COVID policy. Exports should also be supported by the completion of a key railway connecting mines in Mongolia with buyers in northern China.

Figure 5.4: Metallurgical coal exports



Notes: **e** estimate **f** forecast
Source: IHS (2021); Department of Industry, Science, Energy and Resources (2021)

Exports from Canada are set to rise as a new mine ramps up

Canadian metallurgical coal exports are expected to lift slightly in 2022, supported by the restart of Canada Coal's Grand Cache mine, which has historically produced around 2 million tonnes of coal each year. The mine was closed down in 2020, following the outbreak of the COVID-19 pandemic, and while restart may take some time given the eighteen month

period of care and maintenance, it is expected to occur within the outlook period, with most of the production going to the Chinese market.

The return of production at Grand Cache, and generally strong conditions for Canadian exporters, are expected to see exports lift from 28 million tonnes in 2020 to 32 million tonnes by 2023 (Figure 5.4).

Mozambique's exports will take time to recover

Mozambique's exports fell sharply to 4 million tonnes in 2020, as low prices severely affected the country's relatively high cost producers.

Overall exports are forecast to recover to 5 million tonnes in 2021 and to 7 million tonnes by the end of the outlook period, facilitated by rising output from Vale's Moatize mine, where work has finished on a preparation plant upgrade, and by upgrades to the Nacala logistics corridor rail line and port. Higher output at the Moatize site may be temporarily affected by seasonal heavy rainfall, but growth to at least 8 million tonnes of metallurgical coal (annually) is expected over the longer term.

Over the longer term, Mozambique could become a significantly larger exporter of metallurgical coal to Asia.

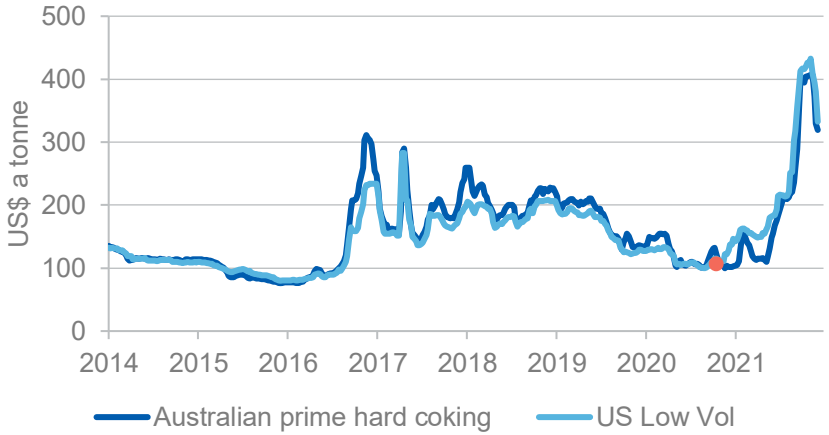
5.5 Prices

Metallurgical coal prices are expected to ease gradually

After surging to historical highs in September, metallurgical coal prices levelled out in October and November (Figure 5.5). Cuts in crude steel production in China did not lead to any easing in prices, but may have curbed further upward momentum. Prices may also have been held in check by some Chinese steel mills to reducing output in order to curb energy use in the face of thermal coal shortages. However, shortages and brownouts in China may also have led to some switching, with low-grade metallurgical coal redirected into thermal coal supplies in order to curb power shortages. Daily steel production and capacity utilisation fell in China in October, and this is expected to continue until the end of the Winter Olympics, creating an additional downward pull on metallurgical coal prices into early 2022.

Some easing in prices is expected during 2022. However, supply is expected to remain tight, with strong steel prices encouraging global production to rise, even as China constrains its output. However, gradual gains in Australian supply, and the withdrawal of remaining global stimulus measures, should help markets to balance, with prices forecast to fall in 2022 and 2023. Informal import restrictions imposed by China on Australia coal could keep prices 'stickier', preventing downward movement and adding to freight costs, forcing global supply chains to continue to adapt.

Figure 5.5: Metallurgical coal prices – Australian Prime Hard vs US Low Vol, FOB



Source: IHS (2021). Low vol = low volatile coking coal. Orange marker indicates approximate timing of informal import restrictions from China.

As supply from Australia and other exporters gradually picks up, prices are expected to ease back from about US$230 a tonne in 2021 to a still-strong US$160 a tonne by 2023 (Figure 5.7). Prices could shift higher in the event of severe weather disruptions in Queensland, which often occur in the autumn. Conversely, changes in Chinese steel policy or COVID-related economic disruptions could pull prices down. The worsening shortage of semiconductors could disrupt supply chains, but is more likely to affect steel demand, presenting a downside risk to prices on balance.

5.6 Australia

Metallurgical coal export earnings are on a strong trend

Slower throughput from Queensland ports in September has added to recent price pressures. However, the slowdown does not appear to have been driven by any structural issues, and appears to have reversed in November.

BHP output slowed sharply (by around 25%) over the September quarter. This largely reflected the impact of maintenance at the Peak Downs and Goonyella sites, and a longwall move at the Broadmeadow mine. A recovery in production is expected to have begun in the December quarter, with output expected to fully recover in the first half of 2022.

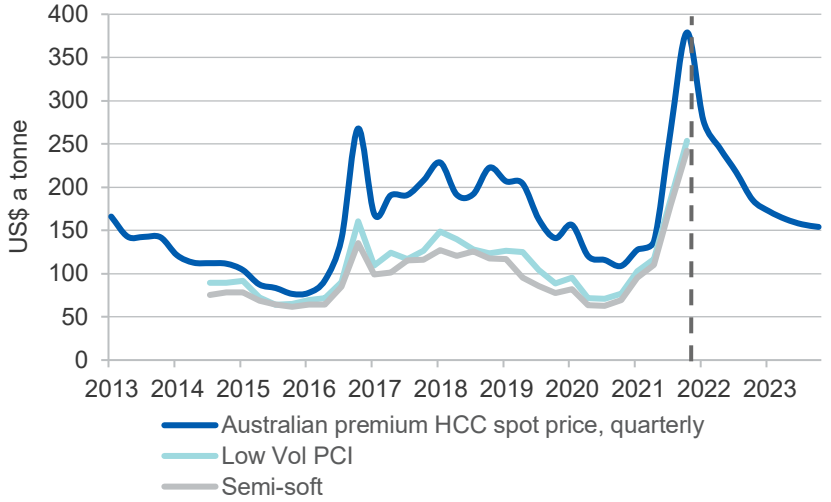
Anglo's Grosvenor mine, which shut down in 2020, is moving closer to reopening. Development has begun at the site, and the final stages of the approval process are now underway, with full commercial operation expected to commence within a few months.

Some projects including Dendrobium, and Appin are planning longwall moves late in 2021 or early in 2022, which may constrain output marginally, though overall production guidance remains relatively solid.

Ownership arrangements of Australian coal mines have shifted in recent months. Stanmore Coal, which is 73% owned by Golden Energy (a Singaporean company) is set to acquire BHP's share in two coking coal mines (at a cost of just over US$1.2 billion). The acquisition of controlling shares in the Poitrel and South Walker Creek mines will make Stanmore a significant investor in Australian coal assets, while BHP continues to transition out of the domestic coal sector.

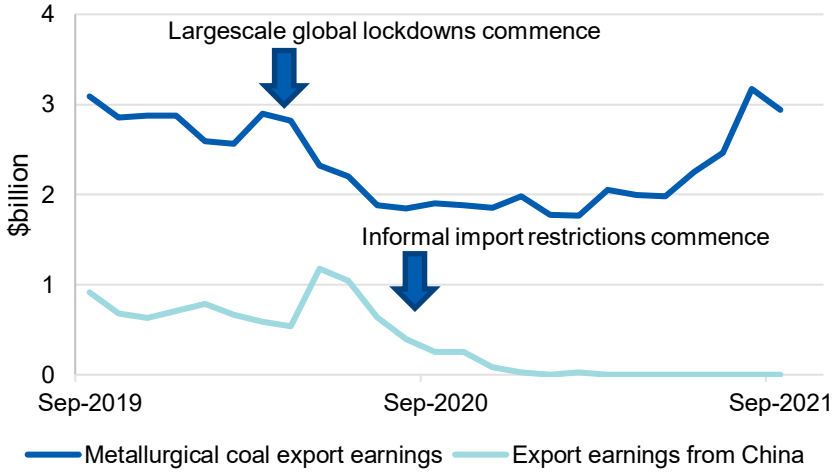
With prices peaking and supply chains now fully adapted to Chinese informal import restrictions, export earnings are well above pre-COVID levels (Figures 5.6 and 5.7), despite some constraint on volumes. Higher demand from India is expected to support Australian exports over the outlook period, with buyers in Japan, South Korea and Taiwan also expressing interest in increased supply.

Figure 5.6: Australian metallurgical coal spot price, quarterly



Source: Platts (2021); Department of Industry, Science, Energy and Resources (2021)

Figure 5.7: Australia's metallurgical coal export values, monthly



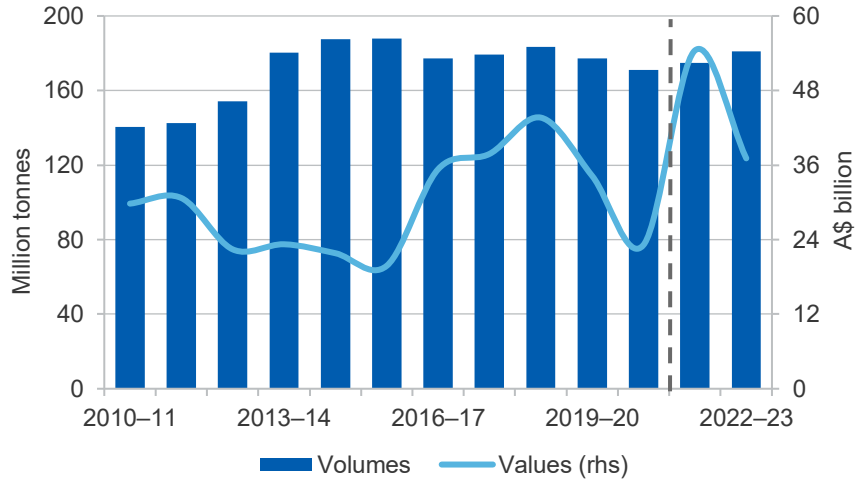
Source: ABS (2021) International Trade, Australia 5454.0

Metallurgical coal export earnings were $23 billion in 2020–21 (Figure 5.8), with the sector affected by the COVID-19 pandemic and, to a lesser extent, by China's informal import restrictions. Prices are set to deliver a large windfall to metallurgical coal producers in 2021–22, with export values forecast to rise to over $50 billion, a new record level. An easing to a still-high $37 billion is expected in 2022–23. Export volumes are expected to grow modestly over the outlook period, driven by a ramp-up at Grosvenor and the completion of maintenance at several BHP mines.

Coal exploration expenditure has declined

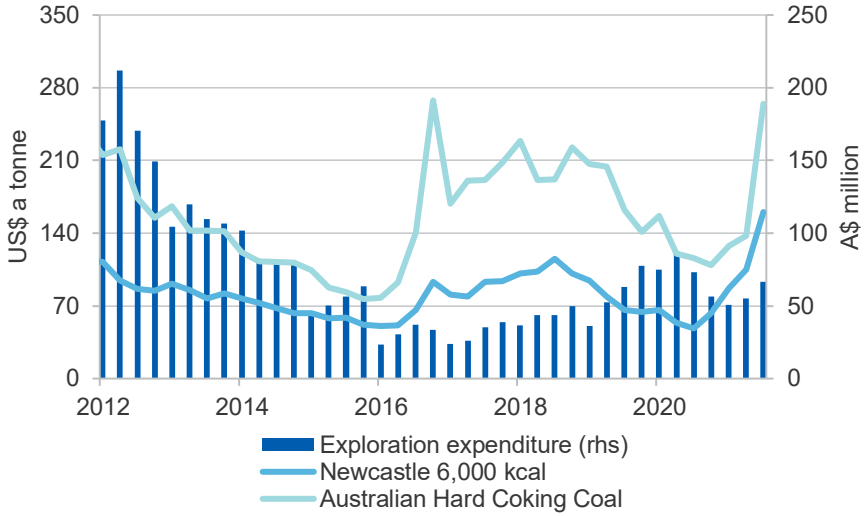
Australia's coal exploration expenditure increased to $66 million in the September quarter, but was still down by 9% from the level recorded in September 2020. Prices have risen markedly for Australian coal in recent months, but thermal coal in particular remains subject to significant policy and financial uncertainty. Price increases may improve rates of exploration over coming quarters, most notably for metallurgical coal (Figure 5.9).

Figure 5.8: Australia's metallurgical coal exports



Source: ABS (2021) International Trade, Australia 5454.0; Department of Industry, Science, Energy and Resources (2021)

Figure 5.9: Australian coal exploration expenditure and prices



Source: ABS (2021); IHS (2021); Platts (2021)

Revisions to the outlook for Australian metallurgical coal exports

Australia's forecast metallurgical coal export earnings have been revised up noticeably (by over $15 billion in 2021-22) due to recent sharp price gains. Volume forecaste remain largely unchanged from the September 2021 *Resources and Energy Quarterly*.

Table 5.1: World trade in metallurgical coal

	Unit	2020	2021[s]	2022[f]	2023[f]	Annual percentage change 2021[s]	2022[f]	2023[f]
World trade	Mt	309	320	334	344	3.7	4.4	2.8
Metallurgical coal imports								
China	Mt	73	55	62	65	-24.2	12.7	4.8
India	Mt	63	70	68	70	10.9	-2.9	2.9
Japan	Mt	42	48	50	51	13.5	4.2	2.0
European Union 28	Mt	34	35	34	32	4.1	-3.5	-3.9
South Korea	Mt	35	36	36	36	3.4	-1.4	0.0
Metallurgical coal exports								
Australia	Mt	172	170	179	184	-0.9	5.3	2.6
United States	Mt	38	42	41	41	10.5	-2.4	0.0
Canada	Mt	33	31	32	32	-6.1	3.2	-1.6
Russia	Mt	30	32	35	37	6.7	9.4	5.7
Mongolia	Mt	26	21	31	33	-19.2	47.6	6.5
Mozambique	Mt	4	5	6	7	25.0	20.0	16.7

Notes: **f** Forecast; **s** Estimate.

Source: IEA (2021) Coal Information; IHS (2021); Department of Industry, Science, Energy and Resources (2021)

Table 5.2: Metallurgical coal outlook

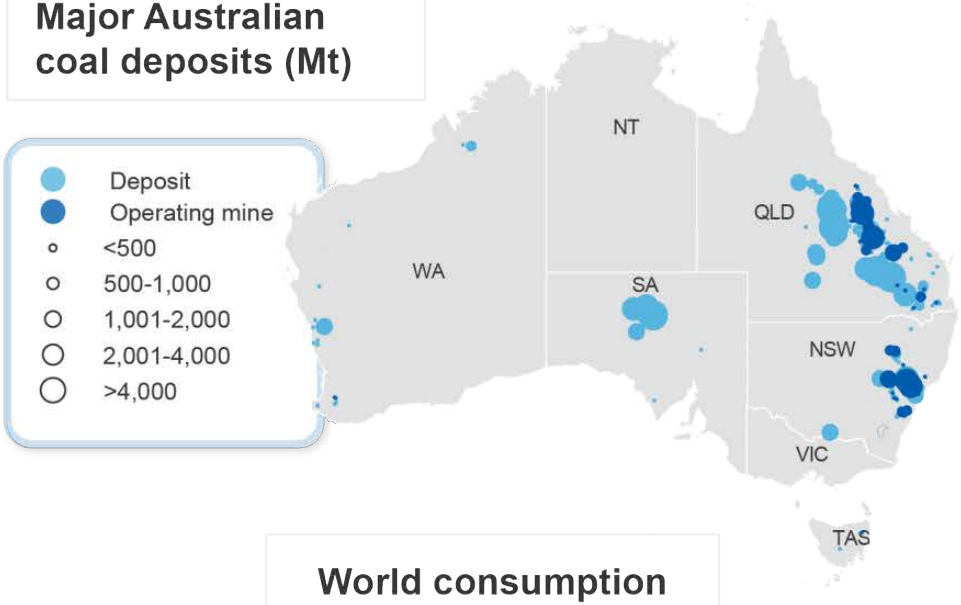
World	Unit	2020	2021[s]	2022[f]	2023[f]	Annual percentage change 2021[s]	2022[f]	2023[f]
Contract prices[e]								
– nominal	US$/t	125	197	238	164	57.3	21.0	-31.0
– real[d]	US$/t	130	197	230	154	51.7	16.9	-32.8
Spot prices[g]								
– nominal	US$/t	125	227	222	162	81.3	-2.4	-27.2
– real[d]	US$/t	130	227	214	152	74.9	-5.7	-29.1
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Production	Mt	183	170	181	186	-6.8	6.3	3.0
Export volume	Mt	177	171	175	181	-3.4	2.2	3.4
– nominal value	A$m	34,245	23,170	54,441	37,083	-32.3	135.0	-31.9
– real value[i]	A$m	35,643	23,731	54,441	36,299	-33.4	129.4	-33.3

Notes: **d** In 2021 US dollars. **e** Contract price assessment for high-quality hard coking coal. **i** In 2020–21 Australian dollars. **f** Forecast. **g** Hard coking coal fob Australia east coast ports. **s** Estimate.
Source: ABS (2021) International Trade in Goods and Services, Australia, 5368.0; Department of Industry, Innovation and Science (2021); Platts (2021)

6 C Carbon 12.011

Thermal coal

Major Australian coal deposits (Mt)



Thermal coal

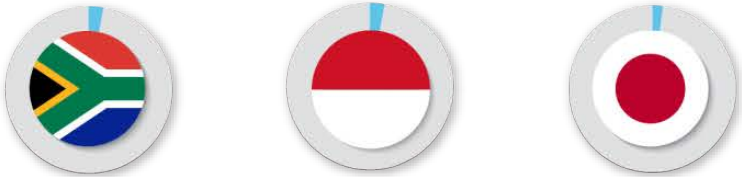
- Thermal coal is primarily used in **electricity generation**
- Coal accounted for **38%** of power generation globally in 2018
- Mines are open cut or underground depending on the **geology of the deposit**
- **Coal formation** began 290-360 million years ago

World consumption

55% China

14% India

8% United States



3% South Africa

3% Indonesia

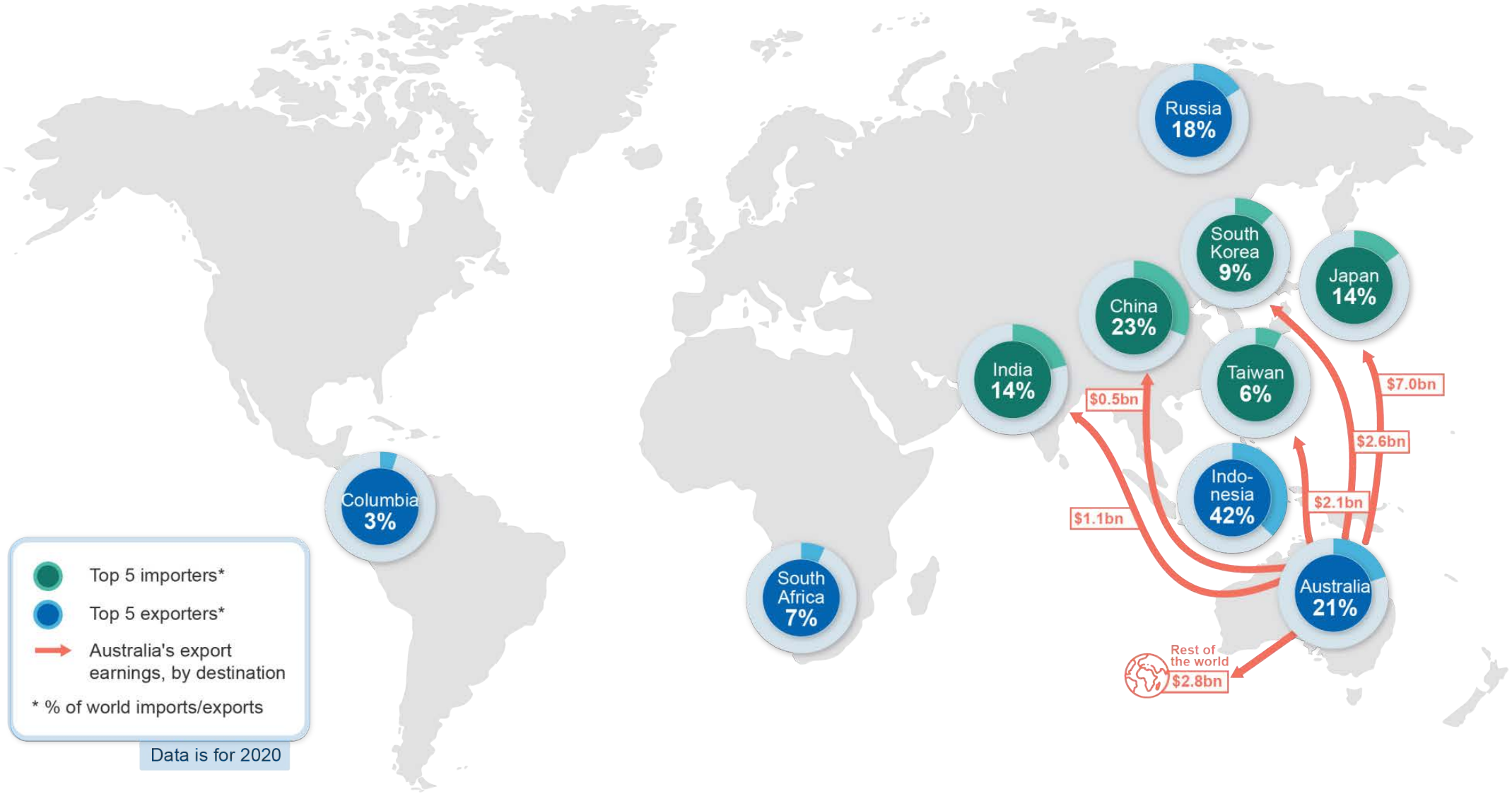
2% Japan

Australia's thermal coal

- **World's 2nd** largest **thermal coal** exporter
- **World's 4th** **largest black coal** resources
- **75-80%** of thermal coal **is exported**

Thermal coal

Trade map | December 2021



6.1 Summary

- Thermal coal spot prices spiked in October as strong Chinese demand hit up against global supply disruptions and capacity constraints. The Newcastle benchmark price is forecast to average US$134 a tonne in 2021, easing slowly to around US$90 a tonne by 2023.
- Australian thermal coal exports declined from 213 million tonnes in 2019-20 to 192 million tonnes in 2020–21, but are expected to recover back to 204 million tonnes by 2022–23.
- Surging prices are expected to push export values up to $35 billion in 2021–22, with a subsequent easing to $27 billion by 2022–23.

6.2 World trade

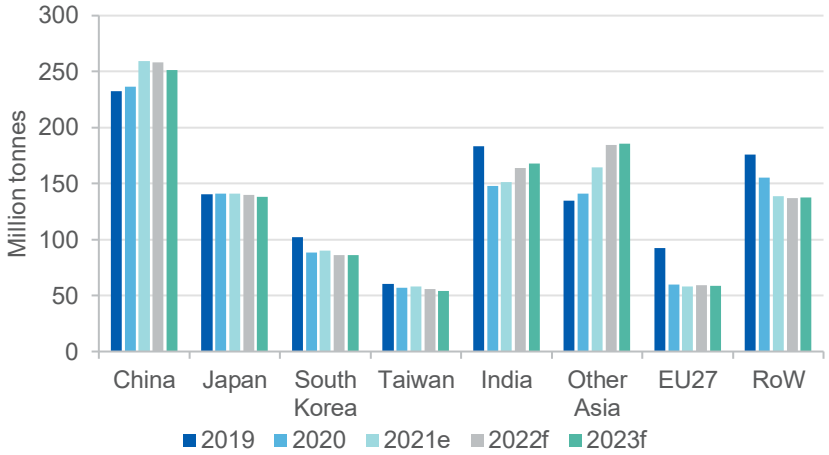
Thermal coal demand appears to be recovering more rapidly than supply. Exports remain below pre-COVID-19 peaks, but a rapid global economic recovery and cold Northern Hemisphere Winter has increased demand for power generation among significant thermal coal importers. This has led to rising pressure on inventory levels and surging prices over the second half of 2021. Key importers, including China and India, are now managing severe pressure on inventories after months of destocking, and Europe is also starting to face inventory shortages.

However, surging prices have not led to a rush of coal investment. Investment in coal remains low amidst market and policy pressure, which has been affected by announcements in and around the recent COP26 summit. Recent commitments by a range of countries (covered in more detail in section *6.3 World imports*) have added to uncertainties over coal investment. This is likely to discourage a number of major investors from responding to the recent price surge, and contribute to a likelihood that thermal coal prices will remain relatively high over the outlook period.

High prices may in turn reduce competitiveness of coal relative to other energy sources, risking potential reductions in its share of global power use. However, some companies and countries with existing coal mining assets are likely to see a significant benefit to profits, especially in light of the ongoing expansion of coal generation and imports in parts of Asia.

The interaction between short-term factors (recovery from COVID-19 and ongoing rollout of new coal plants in South Asia) and long term factors (new policy announcements emerging from the COP26 summit, difficulties with access to capital and insurance) could create significant volatility in prices and trade over the next two years, however policy announcements are not expected to materially impact demand over the next two years.

Figure 6.1: Thermal coal imports



Note: **f** Forecast

Source: IHS (2021); IEA (2021) Coal Market Report; Department of Industry, Science, Energy and Resources (2021)

In volume terms, seaborne imports are estimated to have increased by 7% in 2021 (to 1,060 million tonnes) as COVID-19 disruptions pass. Smaller increases are expected in the subsequent two years, with overall imports expected to reach 1,079 million tonnes in 2023, falling just short of their 2019 peak. Supply is expected to largely match demand in 2022 (Figure 6.1).

6.3 World imports

China's import price premium remains high as import restrictions persist

China is likely to become increasingly dominant in global coal markets over the next few years. A range of South-East Asian countries cancelled a significant number of planned coal plant constructions at COP26, leaving China with a dominant share of all coal plants now under development.

Coal use in China has more than recovered from its decline during the early stages of the COVID-19 pandemic. This has placed significant pressure on Chinese coal supplies, with the Government responding to brownouts and power shortages by directing power plants to boost output at all costs. However, following the recent surge in prices, China's National Development Reform Commission imposed a price ceiling (approximating to US$187 a tonne) in late October. China's size in thermal coal markets — it mines about half of world output — meant that its price cap had a noticeable impact on thermal coal prices, which fell sharply.

The Chinese Government has given no sign of the end of informal import restrictions on Australian coal, even though Australian coal held for some quarters at Chinese ports now appears to have cleared customs.

Domestic output in China is growing, but is encountering significant disruptions. Shanxi — China's largest coal producing province — has faced severe floods, with sixty mines forced to close as a result. Despite this, Shanxi, Shaanxi and Inner Mongolia (all significant coal producing provinces) pledged to raise their output by 145 million tonnes in December. Such a rise would likely reduce pressure on Chinese imports.

China's government has previously announced plans to reduce coal use over the longer term through 'blue sky' and decarbonisation targets, which include a net zero target set for 2060. Attempts to curb coal deployment are also rising in some individual regions of China. This includes the Hong Kong Special Administrative Region (SAR), which continues to progress with long-term proposals to reduce coal imports by converting its largest coal plants (Lamma and Castle Peak) to gas-fired plants. However, conversions of this kind typically take up to 10 years, with coal imports to Hong Kong likely to continue into the 2030s.

India's coal imports are expected to grow each year of the outlook period

India is expected to increase its use of coal over the next two years, with both demand and domestic supply set to expand. Signalling its ongoing intention to use coal, India (and China) advocated for changes to the text of the final COP26 communique, replacing a universal commitment to 'phase out' coal with a commitment to 'phase down' coal.

With post-COVID-19 recovery now well underway, Indian thermal coal imports are expected to rise over the outlook period. Imports of Indonesian coal have risen especially rapidly in recent months, as Australian coal has lost some of its price advantage (Figure 6.2). While imports have become more expensive, India has thus far avoided any significant power shortages. However, over half of its coal-fired plants are now down to less than 3 days of inventory, and demand is still growing.

Pressure on imports may ease over coming months, as power generators attempt to cut back usage amidst urging from the Government for India to become more self-reliant. However, domestic supply is yet to grow to a level that could noticeably curb import pressure. In November 2021, the Indian Power Ministry instructed power companies to build up stockpiles, in the expectation that demand levels would remain high. The instruction came after heavy September rains in coal-mining areas hit the production and delivery of coal.

The Indian Government is also seeking to reduce dependency on imported coal by providing greater access to domestic deposits. The Government ran a series of auctions for coal blocks in 2021, and at the time of writing just over half of the 38 blocks had been purchased. Should work at the sites proceed on schedule, it is likely that new mines would begin to enter the domestic market from the mid-2020s, potentially providing a long-term curb on imports of lower-grade coal. However, this is not expected to have any noticeable impact during the outlook period.

Japan's imports are expected to hold up through the outlook period

Japan has recently escalated its policies for a transition out of coal, with Prime Minister Kishida announcing at COP26 that the country would invest US$100 million in transforming coal and gas plants to use nitrogen and hydrogen. Japan has also expanded its climate finance commitments for Asian nations by US$10 billion, announced plans to close 100 coal plants by 2030, and cancelled its proposals to build more coal-fired power plants.

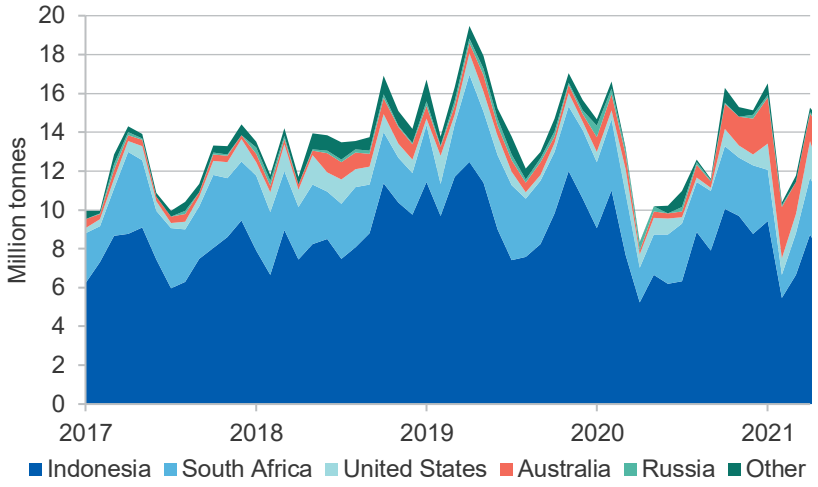
The Japanese Government's 6th energy plan forecasts a significant decrease in coal use by 2030. However, this plan is contingent on large growth in nuclear and renewables, requiring a significant increase in the pace of their reconnection or deployment. Japan also maintains additional coal capacity already under construction, which is unlikely to be cancelled. While recent announcements may affect market sentiment, significant coal imports are expected to last until well beyond the outlook period, albeit with an accelerating decline from the late 2020s.

A notable variable in Japan's coal demand will be the rate of progress in reconnecting its nuclear fleet. Only 10 of the nuclear plants that were closed after the Fukushima accident have re-opened to date, but the Japanese Government has recently indicated that it will seek to accelerate progress on this front. A further 14 plants are expected to open in coming years. Should this occur, coal use and coal imports may decline more rapidly than currently expected.

South Korean coal imports are expected to come under growing pressure

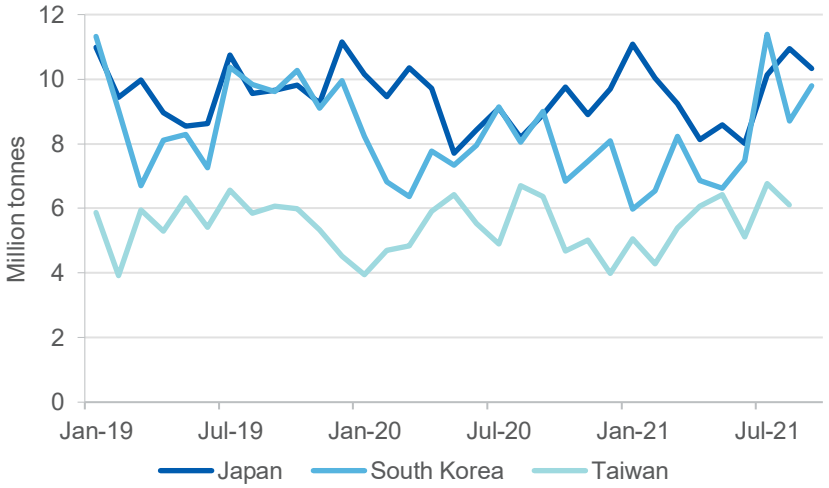
In October, South Korea released a draft plan to reduce coal fired generation from around 42% of electricity generation (in 2018) to 22% (by 2030) and zero (by 2050). This builds on the existing Basic Energy Plan, which seeks to shut about half of the nation's 60 coal fired plants by 2034. Despite these announcements, it is expected that coal generation will nonetheless increase in the near term, with coal imports expected to be supported by high gas prices for the next 2-3 years.

Figure 6.2: India's thermal coal imports, monthly



Source: IHS (2021)

Figure 6.3: Japan, South Korea and Taiwan's thermal coal imports



Source: IHS (2021)

Scheduled maintenance at several nuclear plants may also provide a short-term upside for coal imports, though conditions will likely grow tougher for coal producers towards the end of the outlook period.

Taiwan's imports are expected to start declining slowly

Taiwan has announced that it will cancel all coal plant construction, and reduce the coal share of its power generation from around 45% to 30% by 2025. The Taiwanese Government has also abandoned previous plans to upgrade its coal fleet — much of which was built 30-40 years ago — and will instead seek to convert its coal plants to use gas.

Given the age of Taiwan's coal fleet — around half of which is near end of life — it is expected that coal imports will start to decline modestly during the outlook period, ahead of other countries in the region. However, this may be complicated by plans to downscale nuclear generation in Taiwan, which will add to the scale of energy transition required.

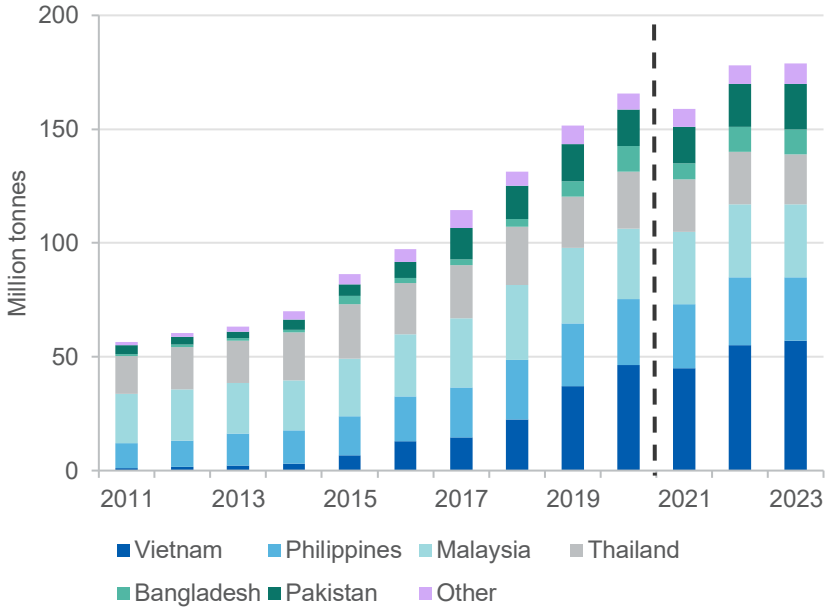
South East and South Asia imports are set to grow

Nations in South East and South Asia (excluding India) collectively import about 150 million tonnes of thermal coal each year. This sum is expected to rise over the outlook period (Figure 6.4), with recent cuts in planned coal capacity not expected to have a measurable impact until the mid-2020s.

In the Philippines, imports have been relatively low over much of 2021, but are expected to rise over the remainder of the year and beyond, especially following the connection of the new Mariveles coal-fired power plant. The Philippines retains a number of coal plants under construction, but has banned greenfield coal projects, and is considering potential early closure of 10 of its 28 existing coal plants.

Thailand's most recent Power Development Plan seeks to phase out coal fired power generation, reducing the share of coal generation by half (to 10%) by 2030. However, industrial demand (notably for cement production) remains robust, and is expected to place a floor under coal imports for the duration of the outlook period at least.

Figure 6.4: South and South East Asia thermal coal imports



Source: IEA (2021) Coal Information; Department of Industry, Science, Energy and Resources (2021); IHS (2021)

Malaysia, which has large, modern and cost-competitive coal plants, is expected to maintain coal imports for the foreseeable future.

Vietnam, which was previously expected to expand its coal power significantly, announced at COP26 that it would dramatically reduce the scale of its coal plant constructions. Vietnam has also recently signed the global "coal to clean power" statement, which effectively commits it to not issuing permits for new unabated coal-fired power generation projects. Other countries to have recently signed the pledge include Canada, Kazakhstan, Poland, Chile, Egypt, Morocco, Korea, and Sri Lanka, along with other countries across Africa and Asia.

6.4 World exports

Global supply chains have successfully reorganised in the wake of Chinese informal import restrictions, with Australian product now being fully redirected to India, Japan, South Korea, and Taiwan.

Indonesia, Russia and Australia remain dominant in global coal export markets, with the former two nations being increasingly drawn to the Chinese market, filling the gap left by Australian supply (Figure 6.5).

Indonesia's exports are rising despite temporary disruptions

Indonesian thermal coal exports remain on track to easily exceed their 2020 levels, recovering solidly (but not completely) from the effects of the COVID-19 pandemic. However, repeated bouts of heavy rainfall through much of 2021 disrupted supply, contributing to recent rises in global thermal coal prices. Access to labour has also been affected by the lingering impacts of the COVID-19 pandemic, and by recent containment efforts.

Indonesia has significant capacity to increase its exports over time. The country has large (albeit relatively low quality) untapped deposits in Kalimantan and Sumatra. Most of these deposits are close to the surface and readily accessible, with good proximity to loading points and ports. However, new coal production is likely to be affected by recent commitments from the Indonesian Government at COP26. These include scrapping future coal plant construction and potentially closing 5.5GW of existing coal plants early in exchange for global support for its wind, solar and geothermal industries.

Government policy has traditionally prioritised domestic supply ahead of exports. However, exports picked up solidly in 2021 as COVID-19 disruptions passed. Exports are expected to hold at around 470-480 million tonnes annually over the rest of the outlook period, while domestic usage grows.

Russia's exports will be supported by improvements in infrastructure

Russian exports have recovered from a series of weather disruptions and accidents during 2021. Russian exports have been heavily supported through 2021 by Chinese restrictions on Australian supply, which created a price premium for Russian product. Expansion of Russian port capacity (from 36 million tonnes to 50 million tonnes annually) is in progress, and is expected to begin operation in 2022. Additional rail freight capacity connecting Russia to markets in East Asia is also under development, with capacity set to grow from 2024.

With bottlenecks on rail supply set to ease, it is expected that Russian exports will grow over the outlook period, and potentially into the late 2020s. Russia has large, high quality and shallow coal deposits. As a result, it has some of the cheapest mining costs in the world, despite the remoteness of many of its deposits.

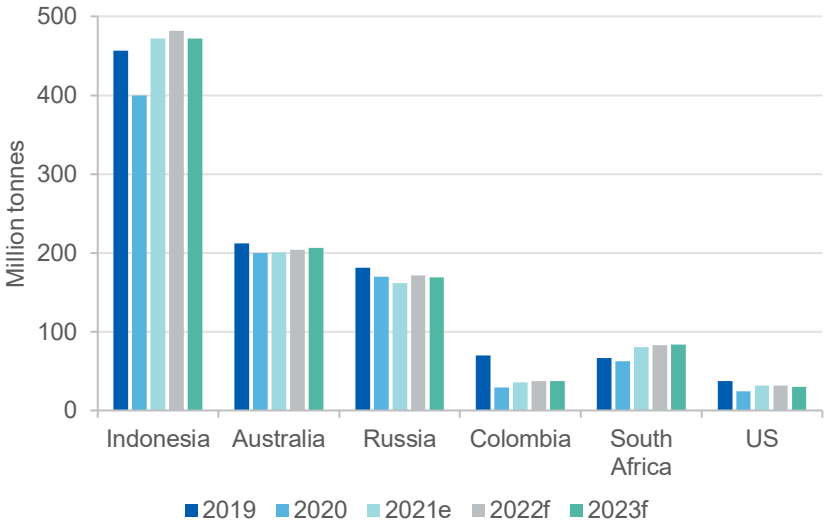
Colombian exports are not expected to recover fully

Columbian exports have faced significant pressure due to declining demand in the European and North American markets. This has pushed remaining exporters to expand their markets in Asia, though export growth on that front is yet to match the declines elsewhere.

Significant mines, including La Jagua and Calenturitas, were also taken offline following falls in regional demand, and are not expected to return to operation in the foreseeable future. The large Cerrejón and Drummond mines remain in operation, though the former continues to face disruptions, most recently to its export route, as a result of protests from indigenous communities and mine workers.

Exports are expected hold their 2021 gains over the rest of the outlook period. However, the permanent closure of some mine sites will prevent exports from recovering to pre-pandemic levels.

Figure 6.5: Thermal coal exports



Notes: **e** estimate **f** Forecast.

Source: IHS (2021); IEA (2021) Coal Information; ABS (2021); Department of Industry, Science, Energy and Resources (2021)

US exports have picked up, but long-term cost challenges remain

US exports have often faced competitiveness issues, due to the long transportation distances (notably between Montana and export terminals in Vancouver, which require rail shipment across the Canadian border). The Atlantic market, which is the main destination for most US coal, has also faced steep demand falls in recent years, albeit with some recovery as economies picked up after the COVID-19 pandemic.

It is expected that the US will remain a marginal exporter; recent price growth and global economic recovery should support exports over the outlook period. However, a string of bankruptcies among the country's largest coal producers has affected market confidence and reduced overall capacity, making it unlikely that US coal exports can recover to match the levels of 2018 and 2019.

Conditions are likely to be slightly stronger for some of the smaller thermal coal exporting countries. South African exports, which are generally of high quality, are expected to remain in demand in Asian markets over the outlook period. Exports from Canada are expected to lift from about 4 million tonnes annually to 6 million tonnes by 2023, supported by a ramp-up of output at the Vista mine, which began production in 2019. Longer term, Canadian exports are likely to reduce in line with the Government's pledge to ban thermal coal exports by 2030.

6.5 Prices

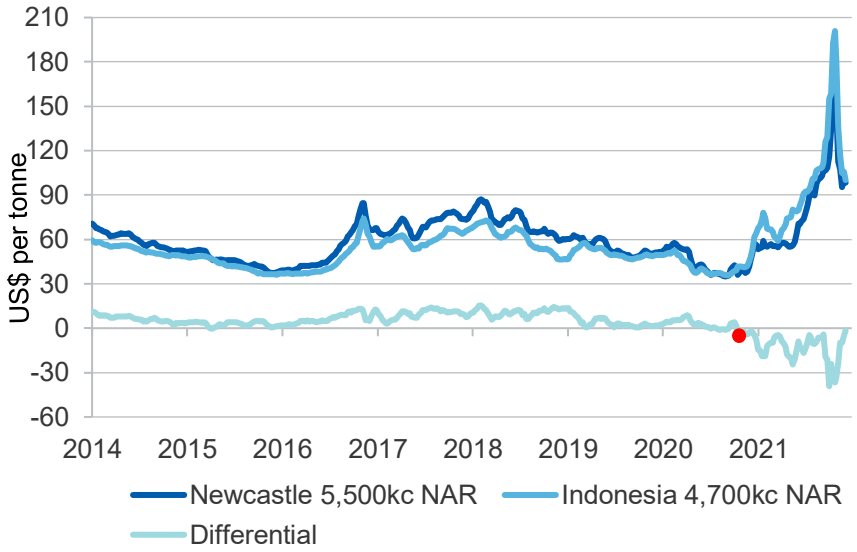
Prices surged during 2021, and are expected to stay volatile and high

Prices rose sharply in the September quarter as a result of a growing supply deficit (Figure 6.6). Pressure on seaborne supply built as China's domestic demand outpaced growth in its domestic supply. Informal import restrictions on Australian coal narrowed China's supply options still further, leading to Chinese domestic prices going over US$350 a tonne. European gas shortages lifted European coal demand, compounding world shortfalls.

With policy pressure dampening investment in new supply, it is expected that prices will remain high and volatile through the outlook period. Rising imports of thermal coal to India, Vietnam and other parts of Asia are expected to put upward pressure on prices, though policy and economic developments in China may be just as influential. Prices outside China have not risen nearly as far as Chinese domestic prices, but have nonetheless spiked due to low inventories. Price pressure in ex-China Asia has been partially checked by access to more affordable Australian coal, and by a still-incomplete recovery in global demand. It is expected that around half of the fall in global seaborne thermal coal trade recorded in 2020 will have reversed itself in 2021.

On balance, the thermal coal price for Newcastle 6,000kcal product is expected to fall to a still-high US$120 a tonne in 2022, and to US$91 in 2023, but there is potential for significant moves in either direction.

Figure 6.6: Thermal coal prices — Australian vs Indonesian



Source: IHS (2021). NAR = Net as received. Red dot indicates timing of Chinese restrictions.

6.6 Australia

Australian thermal coal exporters face volatile conditions in 2021

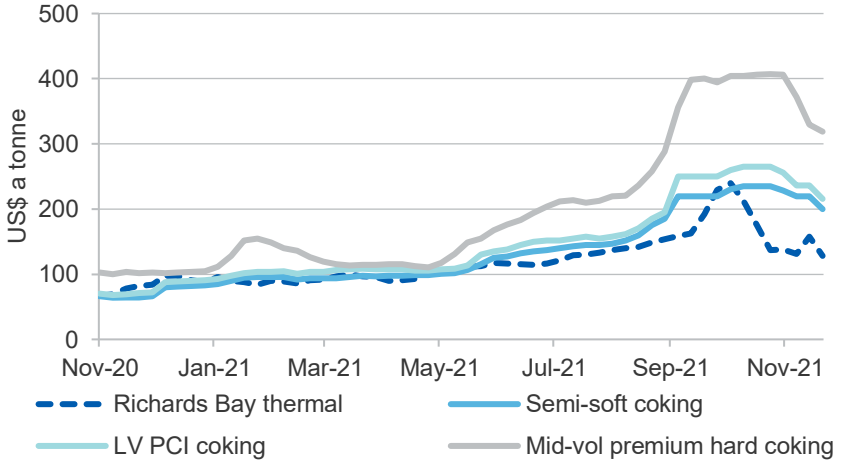
The recent COP26 summit is likely to have mixed effects on Australian coal producers. The recent announcements place additional pressure on long-term prospects for coal demand. Announcements at the summit mean that China will now hold a more dominant share of the world's remaining prospective coal plants, but informal import restrictions on Australian coal mean that Australia is not well placed to capitalise.

However, by deterring investment, it is likely that recent announcements could place coal prices on a higher footing. This provides a strong profit to existing holders of coal mines, who are expected to benefit from global policy pressures and finance obstacles which reduce the chances for future greenfield projects to be developed.

Some proposed coal projects have recently been withdrawn or abandoned, including proposed mines at Dendrobium and the Bylong Valley. The proposed expansion at New Acland continues to face legal objections, with the owners closing the site in response to the depletion of available resources. Twenty workers will remain employed at the mine to conduct maintenance while the approvals process continues. Shenhua's Watermark project has also been shelved, with the NSW Government compensating the company $100 million in exchange for forfeiting development rights at the site.

Partly offsetting this will be the impending ramp-up in output from Bravus' newly opened Carmichael mine. Other potential projects in the Galilee Basin include GVK Group/Hancock's Alpha and Kevin's Corner projects, Waratah Coal's Alpha North and Galilee projects, and AMCI's South Galilee Coal Project. None of these potential projects has been committed to yet, but all of them remain possible.

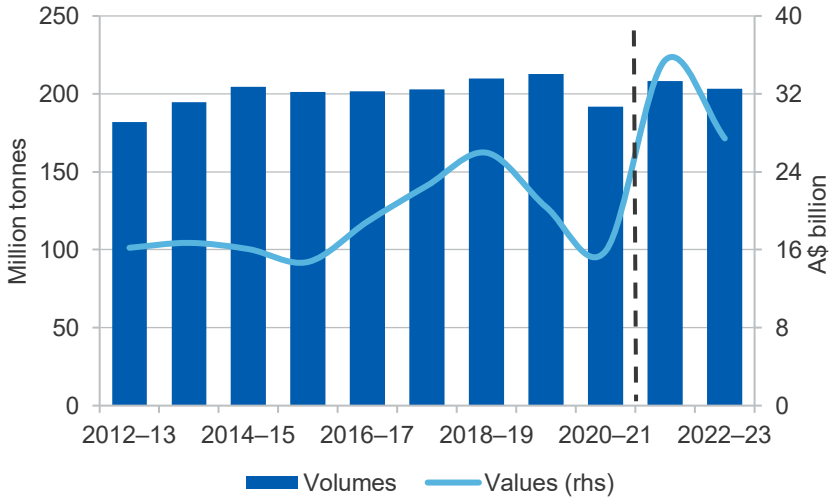
Figure 6.7: Prices for Australian thermal and metallurgical coals



Source: IHS Markit (2021)

Australian coal types remain subject to complex price switching, which has potential to affect export earnings. Notably, premium hard coking coal prices have shifted up relative to lower grade metallurgical coals since mid-2021, and continued to rise for longer (Figure 6.7). The surge in thermal coal prices in October pushed close to parity with lower grade metallurgical coals, providing producers with the incentive to sell unwashed lower grade metallurgical coals into the thermal market. This may have contributed to the recent price fall for Australian thermal coal, and could affect thermal coal export earnings over the next few quarters.

Figure 6.8: Australia's thermal coal exports



Source: ABS (2021); Department of Industry, Science, Energy and Resources (2021)

Monthly export earnings are now well above the levels of 2019, despite the persistence of informal import restrictions from China. In volume terms, thermal coal exports are expected to lift noticeably during the outlook period, rising from about 192 million tonnes in 2020–21 to 204 million tonnes by 2022–23 (Figure 6.8). Export values are forecast to rise up from $16 billion in 2020–21 to $35 billion in 2021–22, before easing back to $27 billion in 2022–23.

Revisions to the outlook for Australian thermal coal exports

Thermal coal export earnings forecasts have been revised up significantly (more than $10 billion in 2021–22) from estimates in the September quarter *Resources and Energy Quarterly*. This reflects a sustained surge in coal prices recorded since the previous publication.

Table 6.1: World trade in thermal coal

	Unit	2020	2021[s]	2022[f]	2023[f]	Annual percentage change 2021[s]	2022[f]	2023[f]
World trade	Mt	1026	1,060	1,084	1,079	7.4	2.3	-0.5
Thermal coal imports								
Asia	Mt	797	864	888	882	8.4	2.8	-0.7
China	Mt	208	259	258	251	24.6	-0.4	-2.7
India	Mt	157	151	164	168	-3.7	8.3	2.5
Japan	Mt	133	141	140	138	6.0	-0.7	-1.4
South Korea	Mt	84	90	86	86	7.1	-4.4	0.0
Taiwan	Mt	53	58	56	54	9.4	-3.4	-3.6
Thermal coal exports								
Indonesia	Mt	399	472	482	472	18.3	2.1	-2.1
Australia	Mt	200	201	204	206	0.5	1.7	0.9
Russia	Mt	177	162	171	169	-8.5	5.6	-1.2
Colombia	Mt	55	36	37	37	-34.5	2.8	0.0
South Africa	Mt	74	80	83	84	7.5	3.8	1.2
United States	Mt	21	32	32	30	52.4	0.0	-6.3

Notes: **s** Estimate **f** Forecast

Source: International Energy Agency (2021); IHS Markit (2021); Department of Industry, Science, Energy and Resources (2021)

Table 6.2: Thermal coal outlook

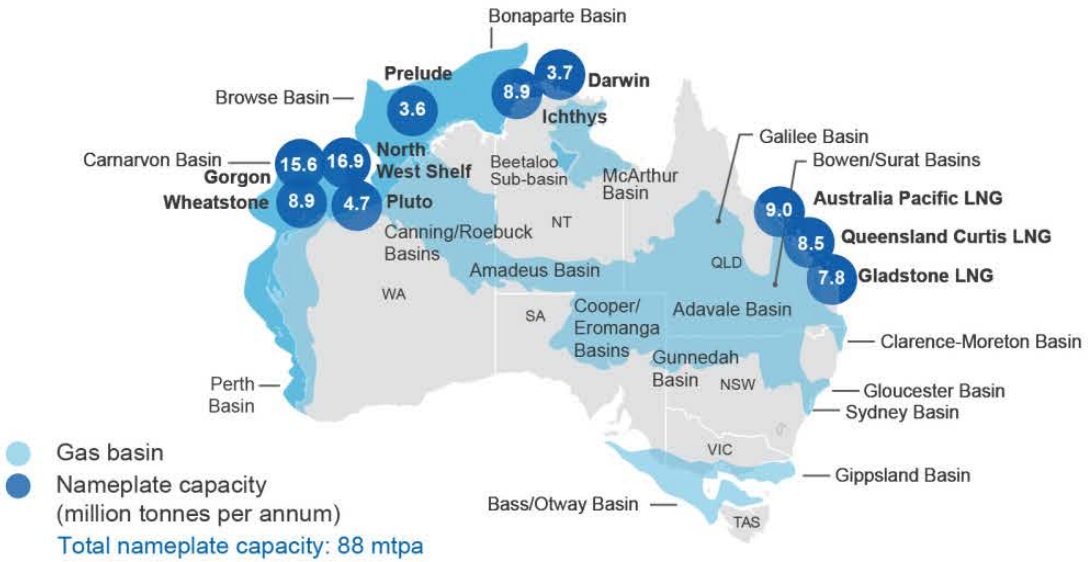
World	Unit	2020	2021[s]	2022[f]	2023[f]	Annual percentage change 2021[s]	2022[f]	2023[f]
Contract prices[b]								
– nominal	US$/t	69	110	93	77	60.0	-15.8	-16.4
– real[c]	US$/t	72	110	90	73	53.7	-18.5	-18.5
Spot prices[d]								
– nominal	US$/t	58	134	120	91	131.3	-10.2	-24.4
– real[e]	US$/t	60	134	116	85	123.1	-13.2	-26.3
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21[s]**	**2021–22[f]**	**2022–23[f]**
Production	Mt	268	228	258	256	-14.9	13.1	-0.7
Export volume	Mt	213	192	208	204	-9.7	8.4	-2.2
– nominal value	A$m	20,376	15,998	35,470	27,432	-21.5	121.7	-22.7
– real value[h]	A$m	21,207	16,385	35,470	26,852	-22.7	116.5	-24.3

Notes: **b** Japanese Fiscal Year (JFY), starting April 1, fob Australia basis. Australia–Japan average contract price assessment for steaming coal with a calorific value of 6700 kcal/kg gross air dried; **c** In current JFY US dollars; **d** fob Newcastle 6000 kcal net as received; **e** In 2021 US dollars; **f** Forecast; **h** In 2020–21 Australian dollars; **s** estimate

Source: ABS (2021) International Trade in Goods and Services, Australia, Cat. No. 5368.0; IHS (2021); NSW Coal Services (2021); Queensland Department of Natural Resources and Mines (2021); Company Reports; Department of Industry, Science, Energy and Resources (2021)

Gas

Australia's LNG projects and gas basins



Gas facts

- LNG is produced by **cooling natural gas to -161°C**
- **LNG shrinks** to 1/600th the volume of natural gas
- **LNG accounted for 12%** of global gas demand in 2020
- Natural gas accounted for **23% of the world's primary energy mix** in 2019

Global gas use by sector

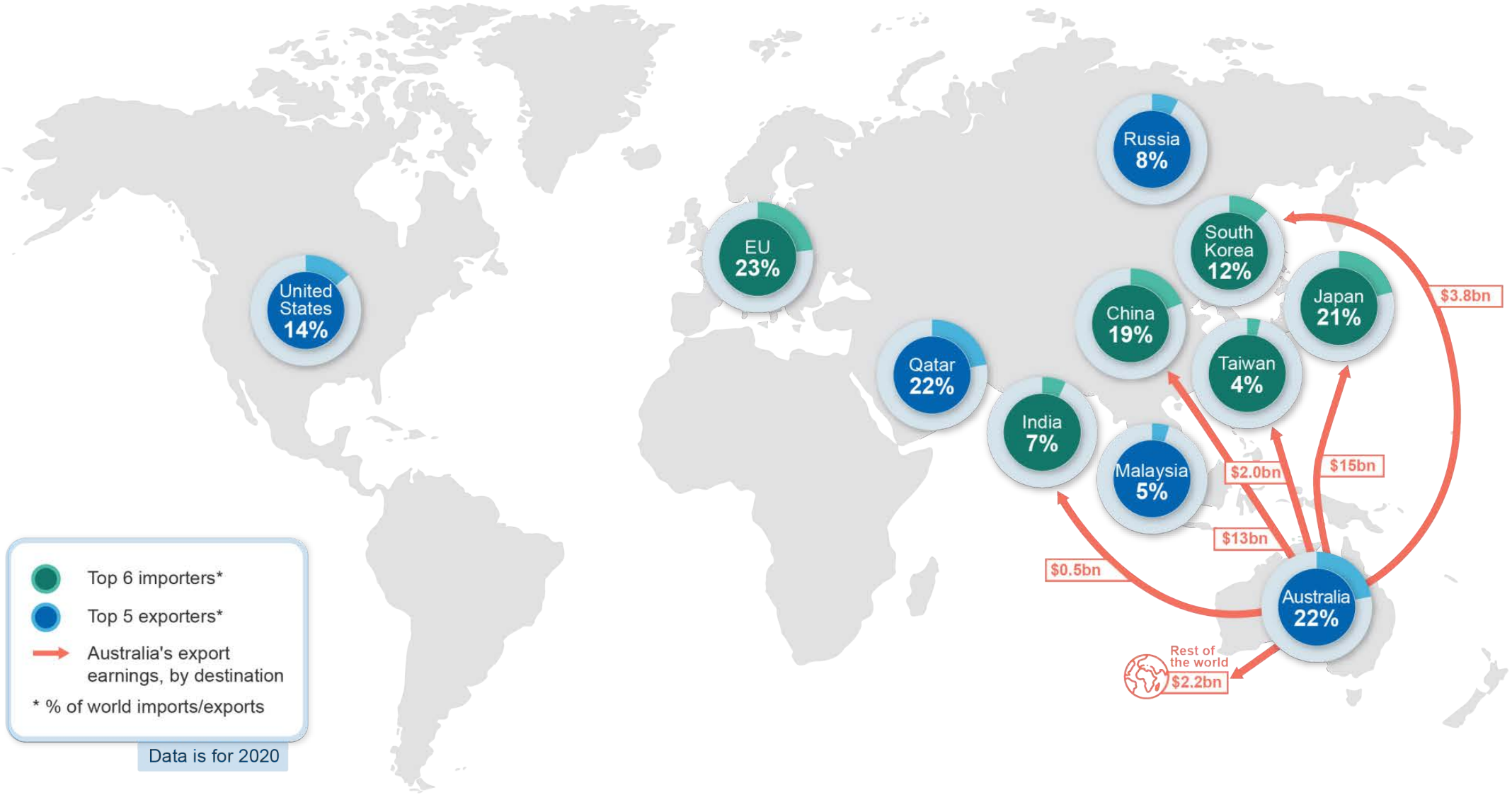
- **20%** Industry
- **19%** Transport
- **22%** Residential
- **40%** Electricity

Australia's LNG

- **78m tonnes exported** in 2020, valued at **$36bn**
- Total **LNG nameplate capacity** is **88m tonnes** per annum
- Around **3/4** sold on **long-term contracts**

LNG

Trade map | December 2021



7.1 Summary

- Asian LNG spot prices and oil-linked contract prices are expected to moderate in 2022 and 2023, as the LNG market remains well supplied and oil prices stabilise around US$70 a barrel.
- Australian export volumes are forecast to increase by 6.5% to 82 million tonnes in 2021–22, as major technical issues are resolved at several plants, and stay stable at 82 million tonnes in 2022-23.
- Australia's LNG exports earnings are forecast to rise from $30 billion in 2020–21 to $63 billion in 2021–22, as oil-linked contract prices surge. Export earnings are forecast to be $55 billion in 2022–23.

7.2 World trade

LNG trade growth driven by Asia-Pacific

Global LNG trade is expected to grow by 2.5% in 2021, as the global economy shows a strong recovery from the COVID-19 pandemic. A number of extreme weather events also raised demand, as the Northern Hemisphere built inventories after a bitter winter, followed by a hot Asian summer and sustained droughts in South America (that affected hydro generation). Asia remains the key driver of import growth, with an impressive 22% growth expected in 2021, largely driven by Chinese demand. High spot prices weighed on demand in some emerging Asian economies, but overall Asian demand remained high.

Various approaches to net-zero policies are expected to affect demand differently — in some cases, including South Korea and India, supporting higher gas demand and in other cases, such as Japan, moving away from gas as a fuel source.

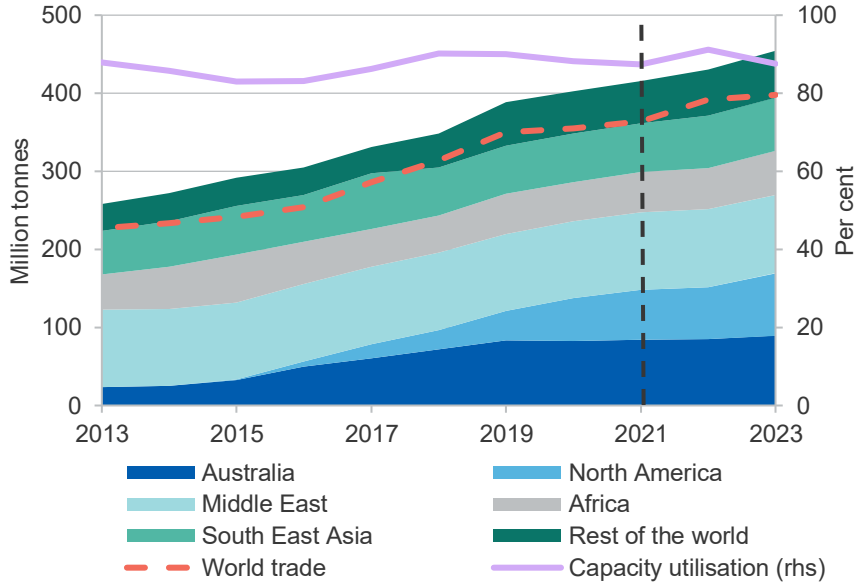
Export growth has been dominated by North America, largely due to the 50% rise in liquefaction capacity since the beginning of 2020. There has been mixed export performance from other regions; exports from the Asia-Pacific have largely been flat, and the Middle East has seen only moderate growth.

The increase in global trade has resulted in a tightening in the LNG shipping market. Spot charter rates have more than doubled from 2020.

Cross Pacific Basin supply routes — from North America into Asia — have seen a considerable increase in traffic, especially through the Panama Canal which saw a record year for LNG tonnage in the US fiscal year 2021 (October 2020 to September 2021).

Global LNG trade is expected to increase by 7.2% in 2022 and by 1.4% in 2023, as demand growth cools following the COVID-19 recovery and the increase in demand from emerging Asia is partially offset by decreasing demand elsewhere. It is expected that there will be periods of market tightness during the outlook as there is minimal supply growth through to 2023. (Figure 7.1).

Figure 7.1: LNG demand and world supply capacity



Source: Source: Nexant (2021) World Gas Model; Department of Industry, Science, Energy and Resources (2021)

7.3 World imports

Japanese LNG demand to slow in pursuit of net-zero

Japan imported 61.1 million tonnes of LNG in the first ten months of 2021 — marginally higher year-on-year — as its economy recovered from the impacts of the COVID-19 pandemic. However, LNG demand generally remains on a downward trend, with Japan predicted to lose its position as the top global LNG importer to China during 2021 (Figure 7.2). As at October 2021, Japan had imported 4.4 million tonnes of LNG less than China. Import volumes are not expected to be high in the December quarter: Japanese LNG inventories were at a 5 year high as winter began, allowing Japanese utility companies to avoid buying at high prices. However, cooler than average weather is predicted for Japan over the winter. Against a backdrop of a drawn out nuclear restart process and maintenance at some coal plants, this would drive up gas demand.

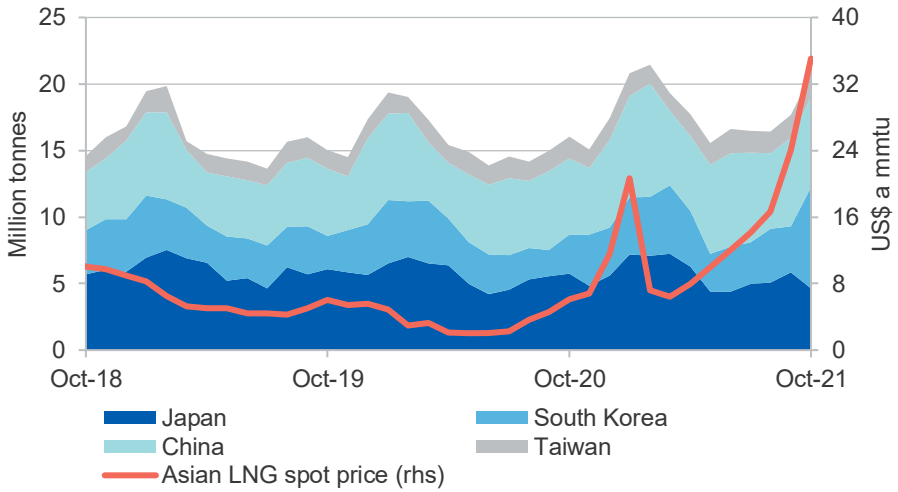
Following the announcement of a net zero by 2050 target in October 2020, the Japanese Government approved the 6th Strategic Energy Plan in October 2021, which details provisional power generation mix targets for 2030. The draft plan incorporates a large swing towards nuclear and renewables generation, with the share of gas proposed to decline from 37% to 20%. While increasing nuclear generation has been a centrepiece of Japanese energy policy for some time now, the rate of increase in nuclear power generation remains slow (at 6% of total). As at November 2021, only 10 of 33 potentially operable nuclear reactors are online.

Japan's LNG imports are estimated to be steady at 74 million tonnes in 2021, supported by delays on nuclear power plant restarts caused by safety and anti-terrorism upgrades, as well as local community pressure. LNG imports are expected to fall in 2022 and 2023, due to energy efficiency improvements and higher nuclear output.

China forecast to be the world's largest LNG importer in 2021

LNG imports were lower in the September quarter 2021, down 7% year-on-year, due to the high Asian spot prices. High gas prices have led to cuts in usage in the transport sectors and a slowing of demand growth from the industrial sector, but have not stopped a significant stockpiling effort. LNG consumption in the December 2021 and March 2022 quarters will be highly dependent on weather, with the National Climate Centre predicting a weak-to-moderate La Nina event which may bring colder than average weather and increase demand. The resurgence of COVID-19 outbreaks remains a downside risk to consumption.

Figure 7.2: Asian LNG imports and spot price



Source: Bloomberg (2021); Argus (2021)

China's demand for gas is expected to increase by around 13% in total over the outlook period — driven by the industrial and residential sectors and ongoing coal-to-gas switching. The Chinese Government's 14th Five Year Plan indicates that gas will play an important role in the energy transition neded to meet its 'carbon-neutral by 2060' pledge. Whilst growth is expected across all supply sources — domestic production, pipeline imports and LNG imports — it is likely that the pace of growth of domestic production and pipeline imports will outstrip LNG in the near term.

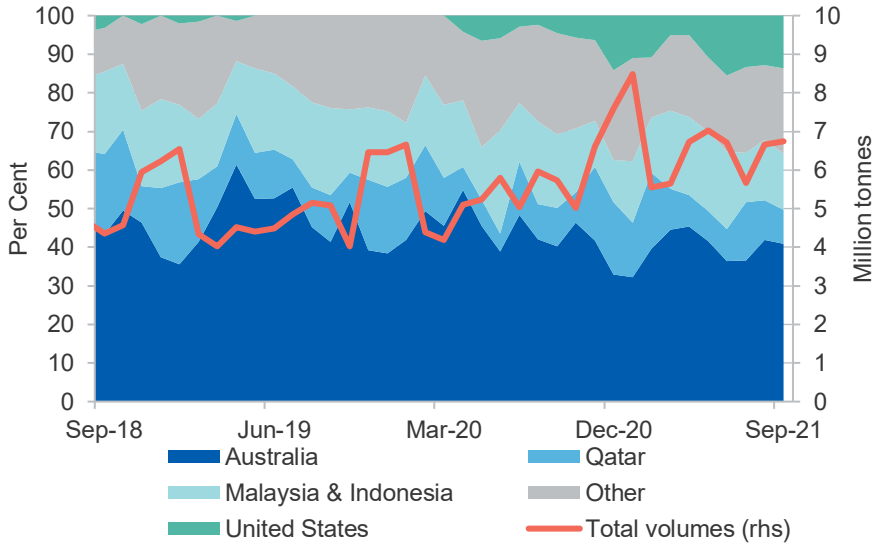
It is expected that China will become the world's largest LNG importer in 2021, importing 80 million tonnes of LNG — 6 million tonnes more than Japan. While the share of LNG in Chinese gas demand is estimated to

decline marginally in 2021 — from 28% in 2020 to 27% — Chinese LNG imports are expected to continue to grow significantly to meet energy demand, rising by an average 5.4% per year over the next two years.

China currently has a pipeline of 24 new or expansion projects under construction to increase regasification capacity. As a result, it is projected that terminal capacity will grow faster than demand during the outlook period. It is also expected that China will increasingly turn to the spot market to source additional LNG, as a considerable gap is emerging between demand for LNG and their contracted volumes.

In 2020, Australia accounted for the largest share of China's LNG imports, at around 43% (Figure 7.3). However, throughout 2021, China has typically sought to diversify its LNG sources, signing new supply contracts with the US and Qatar, and seeking other suppliers on the spot market.

Figure 7.3: China's gas supply by source



Source: Bloomberg (2021); National Bureau of Statistics of China (2021) General Administration of Customs

South Korea's LNG demand to increase due to coal-to-gas switching

In 2020, South Korea's LNG imports were weighed down by the combined impacts of the COVID-19 pandemic on power demand, increasing nuclear generation, and high levels of gas inventories. Overall, imports fell 4.8% to 40 million tonnes in 2020. Demand has recovered in 2021, with 38 million tonnes consumed in the first ten months of 2021, up 17% compared to the first ten months of 2020. Growth has been driven by the ongoing economic recovery and the continued trend of coal-to-gas switching. Nuclear power generation is expected to increase in the December quarter, as the Hanbit No. 4 reactor is brought back online, which may adversely impact LNG demand. Growth in LNG imports is expected to be relatively modest in 2022 and 2023, as new nuclear and coal capacity puts downward pressure on LNG usage in the power sector.

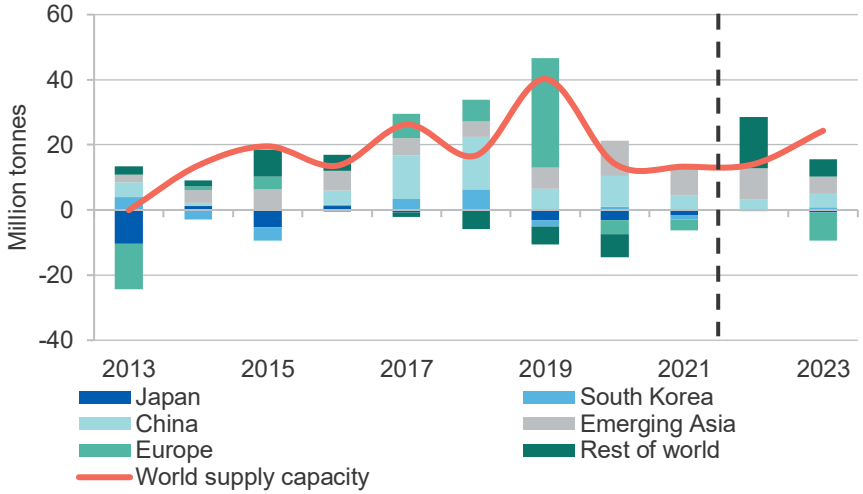
Following the announcement of a 'net zero by 2050' target in late 2020, the South Korean Government has released a number of detailed strategies — including the 14th Natural Gas Plan — which outline the country's move to net-zero through an increase in renewables and a move away from both nuclear and coal-fired power generation. These policies are expected to directly support LNG imports through to 2034.

Taiwan's LNG demand dependent on new import terminals

In the first nine months of 2021, Taiwan's imports have been strong, reaching 14.5 million tonnes. Gas-fired power generation is expected to continue to grow through the outlook period, as the government pursues a policy which would see all nuclear power phased out by 2025. Gas is expected to make up 50% of the electricity mix by 2025, up from 35% in 2020.

Taiwanese LNG imports are forecast to be fairly stable at 18 million tonnes over the outlook period. Taiwan's existing LNG import terminals are both operating at full capacity. The government has announced three new import terminals are now in the project pipeline. A referendum will be held on 18 December 2021 allowing the public to vote on the proposed location of the first terminal, after concerns were raised by environmental groups.

Figure 7.4: World LNG import changes



Notes: Emerging Asia includes India.
Source: Nexant (2021) World Gas Model; Department of Industry, Science, Energy and Resources (2021)

Indian LNG demand remains volatile and price sensitive

India's LNG imports are likely to be lower in 2021 than 2020, with demand mildly impacted by the surge of COVID-19 cases earlier in the year, and then noticeably impacted by the high spot prices later in the year. Indian LNG buyers are highly price sensitive and cut LNG imports as spot prices reached record highs, both in early 2021 and in the second half of the year. Buyers in India left several spot LNG tenders unawarded due to the high prices. India's LNG imports were 3% lower year-on-year in the first nine months of 2021. Overall, 2021 LNG imports are expected to be around 24 million tonnes, 8% lower than in 2020.

Looking forward, India's LNG demand growth depends on a number of factors. In the near term, domestic gas output will continue to surge, with output expected to rise 17% in 2021, and further gains expected in 2022 and 2023. In addition, a range of infrastructure — including import terminals and pipeline connections to transmission systems — is expected to come online over the outlook period, lifting LNG demand prospects.

European imports down as cargoes diverted to Asia

Europe is currently experiencing an energy shortage, with prices for oil and gas rising to well above recent averages. This is forcing gas-to-coal switching at a time when coal prices are also historically high. A number of factors have contributed to the current crisis. Energy demand has surged, as the economy recovers from the COVID-19 pandemic amidst a successful vaccine roll-out. Extreme weather events — including a colder-than-average winter in 2020–21 — have further added to demand. On the supply side, lower than expected renewable generation has coincided with supply chain disruptions, including lower Russian pipeline gas flows and low domestic production in Europe. As a result, European gas prices have soared, with TTF prices increasing over 500% year-on-year.

Whilst Europe has traditionally played a key role in balancing the global LNG market — absorbing excess supply through to its extensive storage capacities — it has entered the 2021–22 winter with gas inventories significantly below its 5-year average. As Asian economies, especially Japan, Korea and China, have endeavoured to replenish gas stockpiles over 2021, there has been increased competition for spot LNG cargoes, and Europe has routinely been priced out. As a result, overall LNG imports are expected to be slightly down in 2021.

The European gas market is expected to be tight for some time — with limited signs of any significant increase in Russian supply and continued demand competition from Asian countries. The level of Europe's gas inventories at the end of winter will be a significant factor in the tightness of the market throughout 2022. BNEF modelling predicts that a colder-than-average winter could see Europe's storage fall as a low as 4%.

Looking forward, European LNG import demand is forecast to fall, reflecting the ramp up of two new gas pipelines and a general softening of gas demand (Figure 7.4). The Trans Adriatic Pipeline began commercial operations in November 2020, and has an annual nameplate capacity of 10 billion cubic metres (about 7.4 million tonnes of LNG). In the first half of 2021, 3 billion cubic metres were delivered through the pipeline, with more than 5 billion cubic metres expected over 2021 as a whole.

The other European gas pipeline, Nord Stream 2, has faced delays due to geopolitical tensions. The first line has been laid, and US President Biden announced in May 2021 that the US Government was waiving sanctions on the companies involved with Nord Stream 2. Gas is not expected until January 2022 at the earliest. The pipeline will transport up to 55 billion cubic metres of pipeline gas each year from Russia to Germany (equivalent to 40 million tonnes of LNG).

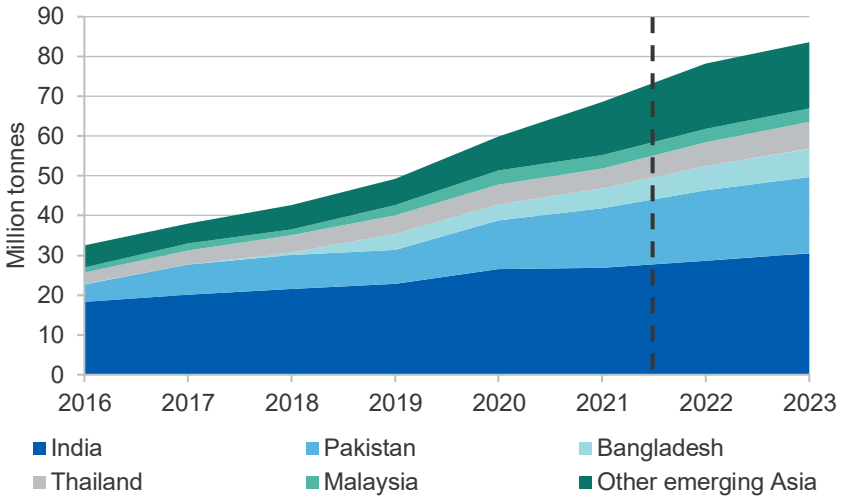
As a result of assumed higher pipeline gas imports, European LNG imports are forecast to fall from 82 million tonnes in 2020 to 69 million tonnes in 2023.

Emerging Asia to significantly increase LNG imports

Other South and South-East Asian economies were a major source of demand growth in late 2020 and throughout 2021. Unlike India, both Bangladesh and Pakistan's LNG imports have been resilient to high prices and COVID-19 disruptions this year. Pakistan's LNG imports are estimated to grow by 14% in 2021, compensating for domestic gas decline and growing industrial demand in the wake of the recovery from the COVID-19 pandemic. Bangladesh's LNG imports are estimated to grow by 17% in 2021, led by the industrial and energy sectors. In the short term, re-gasification capacity is hindering further growth, however, both nations have set plans to add further capacity.

Over the outlook period, imports by emerging Asian economies are expected to increase, due to declining domestic gas production, the expansion of gas-fired power generation and new LNG infrastructure developments. Individually, these countries are relatively small importers of LNG, but collectively are expected to account for a noticeably larger share of global LNG demand. The region (including India) is forecast to import 84 million tonnes of LNG in 2023; 44% higher than 2020 volumes (Figure 7.5).

Figure 7.5: LNG imports from emerging Asian countries



Source: Nexant (2021) World Gas Model; Department of Industry, Science, Energy and Resources (2021)

7.4 World exports

Outlook for investment in new supply looks promising

In 2020, weak spot LNG and oil prices, along with the general uncertainty from the COVID-19 pandemic, caused multiple final investment decision (FID) deferrals. Only one liquefaction project was approved — Sempra Energy's 2.5 million tonnes per annum (mtpa) Costa Azul project in Mexico. At the end of 2020, global LNG capacity was about 450 mtpa, with another 125 mtpa of capacity being built or sanctioned for development.

However, with high spot prices and global demand for LNG showing no signs of slowing down, investment momentum has been building. 45 mtpa of new capacity has been sanctioned to date in 2021. A FID was made on Qatar Petroleum's 33 mtpa North Field East project, worth US$29 billion and potentially the world's largest LNG project by capacity. Woodside made a FID on the $16.5 billion Scarborough and Pluto Train 2 project in late November.

There is a significant pipeline of projects expected to make FID in 2022. These projects span the US, Canada, Qatar and Russia, and could result in over 82 million tonnes of additional capacity being sanctioned. With a majority of these projects not starting production until after 2025, it is likely there will be significant periods of market tightness over the outlook period, as global demand increases rapidly but supply is largely constrained.

US exports to rise in the short-term

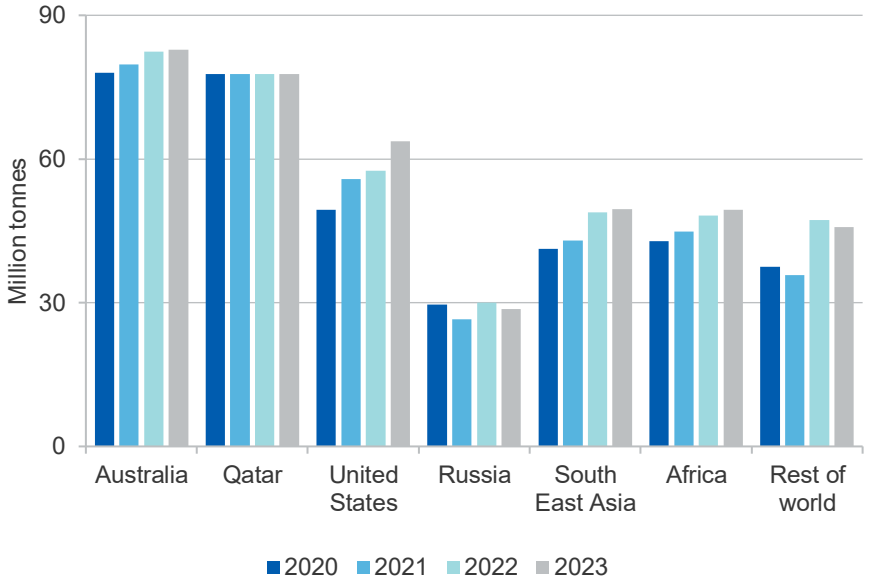
Despite record lows in the US in mid-2020, US LNG exports recovered strongly in the latter half of 2020, to reach record-highs in March 2021. Since then, export volumes have stabilised between 5.6 and 6.6 million tonnes each month; a historical high. The June quarter 2021 saw the highest LNG exports on record at 18.6 million tonnes. The September quarter, which included some routine maintenance, was close behind at 18.4 million tonnes. The large price differences between the domestic Henry Hub price and the spot prices in European and Asian markets has been driving higher than average US LNG exports. Exports are expected to remain strong in the December quarter 2021, with no routine maintenance scheduled. High prices are expected to see exports remain strong heading into 2022.

It is expected that the Calcasieu Pass facility and the Sabine Pass Train 6 will begin ramping up production in late 2021 or early 2022, with first shipments some time afterwards. These two projects combined could eventually add 15 million tonnes of liquefaction capacity. However, the Calcasieu facility is likely to have a very gradual ramp up, due to its modular infrastructure.

Qatar exporting at maximum capacity

Amidst the energy crisis and strong global demand for LNG, the Qatari Government has stated that the nation is operating at maximum capacity and is unable to increase exports to boost global supply. Significant investments have been made to expand Qatar's LNG capacity, most notably the $US29 billion North Field East project — scheduled for completion in late 2025. This project could lift Qatar's export capacity to about 110 million tonnes, from its current 79 million tonnes.

Figure 7.6: Outlook for global LNG exports



Source: Nexant (2021) World Gas Model; Department of Industry, Science, Energy and Resources (2021)

Qatar's LNG exports are forecast to be relatively steady between 2021 and 2023, at about 79 million tonnes, with high levels of capacity utilisation (Figure 7.6).

Shipping data indicates that Qatar was likely the world's largest LNG exporter in 2020, slightly surpassing Australia. However, given the marginal difference between the two country's exports, and uncertainty surrounding the precise level of Qatar's LNG exports, an accurate assessment is difficult. However, Australia is expected to export higher amounts than Qatar over the outlook period.

7.5 Prices

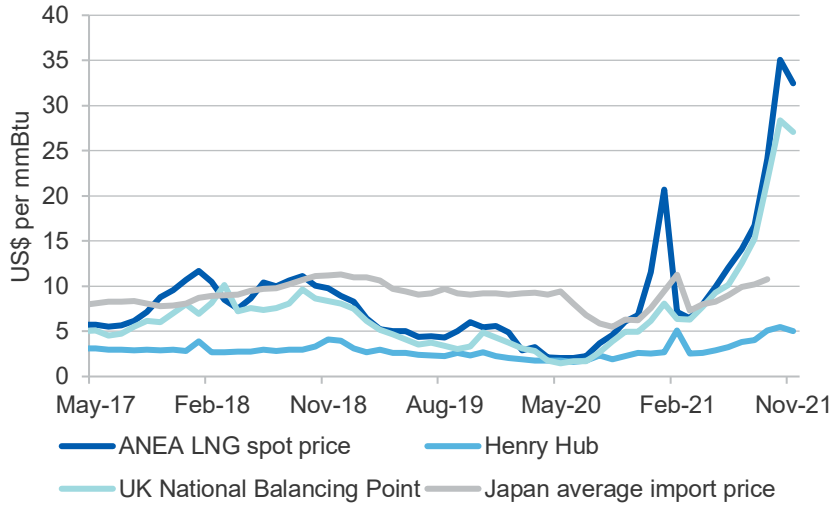
LNG spot prices have continued to show extreme volatility

Asian LNG spot prices have been highly volatile throughout 2021. Low inventories left the market vulnerable to supply problems and stronger than expected demand. Prices spiked to a record price of US$39.7 a mmBtu on 13 January 2021 (due to a bitterly cold Northern Hemisphere winter), before falling back. After averaging US$9.95 a mmBtu in May, the price rose to US$35.1 a mmBtu in October. On 6 October 2021, prices broke the record for a second time in 2021, reaching US$42.1 a mmBtu.

The steady increase in North East Asian spot prices has been driven by a number of factors, including the 'energy crisis' that has been occurring throughout Europe and parts of Asia. A colder-than-average Northern Hemisphere winter of 2020–21 left both Asia and Europe with heavily depleted gas storage levels, leading to increased competition in the spot market as both major importing regions sought to complement contracted cargoes. Against this backdrop, in Europe lower renewable generation, lower levels of domestic gas supply and interruptions to Russian pipeline supply have all pushed TTF and NBP prices to extremely high levels. The Asian LNG spot price has tracked closely to the TTF price over this period, as arbitrage plays kicked in. Against this backdrop, there were also significant supply disruptions to the global LNG market, which peaked in May-June 2021. These disruptions removed as much as 17 million tonnes of capacity from the market, largely due to maintenance deferred from 2020 due to COVID-19.

North-East Asian spot prices are expected to average US$33.5 a mmBtu in the December quarter 2021. Prices are expected to hold at a relatively high level through the rest of the Northern Hemisphere winter, although this will be dependent on the severity of the winter weather. Winter storage levels in Japan and Korea are very healthy, while Europe is still sitting well below its 5 year average. In this environment, a repeat of last winter's harsh conditions could push European storage as low as 4% which would have a significant impact on prices in 2022. Against this backdrop of market tightness, prices have been highly responsive to any supply-side announcements — for example on 17 November, North Asian spot prices jumped US$4.50 on the announcement of unplanned maintenance at Australia's Gorgon facility.

Figure 7.7: Global gas and LNG prices, monthly



Notes: ANEA is the Argus Northeast Asia spot price. LNG prices are DES (Delivered Ex Ship), which include shipping and insurance.

Source: Argus (2021); Bloomberg (2021)

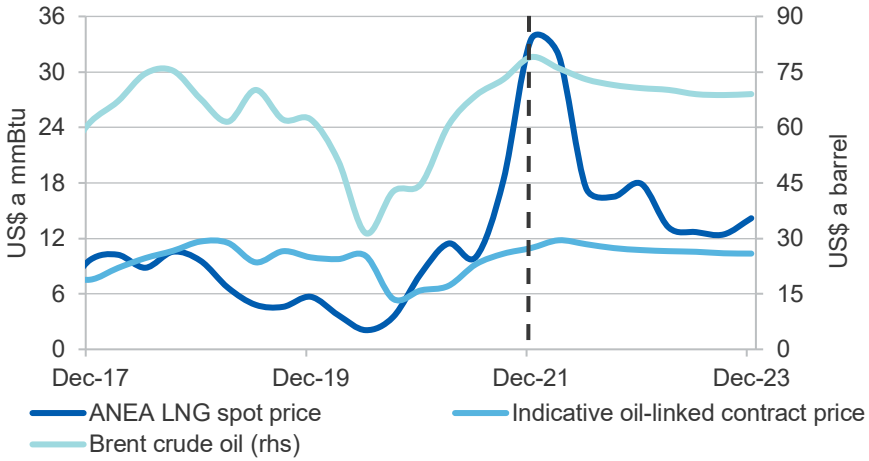
The price is expected to average US$31.8 a mmBtu in the March quarter 2022. After this, prices are expected to fall noticeably. Prices are expected to average US$17.3 a mmBtu for the remainder of 2022, and US$13.1 a mmBtu in 2023. Prices are expected to pick up in the December quarter 2022, reflecting higher demand in the northern hemisphere winter (Figure 7.8).

Oil-linked prices forecast to remain high for some time

Almost 70% of the LNG traded in Asia is sold via long-term contracts that link the price of the LNG to the price of oil (commonly the Japanese customs-cleared crude price), typically with a lag of around three to six months — depending on contractual arrangements.

Oil prices averaged US$73 a barrel in the September quarter 2021, driven by supply restraint by major producers — especially OPEC+ members — and a strong rebound in consumption. Due to the contract lag of several months, these oil prices were reflected in LNG contract prices in the December quarter 2021 and into the March quarter 2022.

Figure 7.8: ANEA LNG spot and contract prices, quarterly



Notes: ANEA is the Argus Northeast Asia spot price. LNG prices are DES (Delivered Ex Ship), which include shipping and insurance. The long-term oil-linked contract price is indicative, and is estimated at 14% of the 3-month lagged JCC oil price plus shipping.

Source: Argus (2021); Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021)

Contract prices are bound to have increased further in the December quarter 2021, reflecting ongoing oil price gains. In the first two months of the December quarter 2021, oil prices were sitting consistently above US$80 a barrel, although some nations are looking at taking measures to ease the oil price by releasing reserves. In the December quarter 2021, oil prices are expected to average about US$79 a barrel (see *Oil chapter*).

Over the outlook period, oil-linked contract LNG prices are expected to fall slightly, as oil prices settle back. Oil prices are forecast to settle at around US$70 a barrel over the outlook period. However, current high prices are likely to continue to flow through LNG contracts for another 12 months.

7.6 Australia

Australia's LNG export volumes recovering from production issues

Australia's LNG export volumes have been relatively resilient throughout the COVID-19 pandemic, with fluctuations in export volumes largely explained by technical issues and routine maintenance. In the September quarter 2021, Australia's LNG exports totalled 21.4 million tonnes, up 14.4% quarter-on-quarter and 16.2% year-on-year. The increase in production has largely been driven by the resolution of issues at Gorgon, Prelude and Ichthys LNG plants in the June quarter.

Production at Gorgon has increased following the completion of repair works at the end of July. Production has been limited since May 2020, when technical issues were detected in the heat exchanger of Train 2. After repairs were completed, Train 1 was taken offline for inspection, and similar issues to Train 2 were found in January 2021. Production in the September quarter was up 53% on the June quarter 2021, and up 55% year-on-year. Production in the September quarter was 4.1 million tonnes, which is 0.2 million tonnes above nameplate capacity.

Prelude FLNG has also gone through significant production disruptions, and was offline between February 2020 and January 2021. Production has been slowly increasing, with 0.8 million tonnes of LNG shipped in the September quarter. This was around 89% of nameplate capacity on a quarterly basis. Production was up 54% compared to the June quarter.

Ichthys also experienced technical issues and routine maintenance in the June quarter, only operating at 54% of nameplate capacity. These issues were resolved in the September quarter with the facility producing above nameplate capacity.

These improvements in production have outstripped the lower production (comparing the September quarter 2021 to the June quarter 2021) from the North-West Shelf (NWS), Pluto and APLNG in the September quarter, all due to extensive routine maintenance.

Australia's export earnings recovering off the back of strong oil prices

In the September quarter 2021, Australia's LNG export earnings increased to $14.2 billion, up 62% quarter-on-quarter and 134% year-on-year (compared to the September quarter 2020). Export earnings were supported by both high LNG spot prices, averaging US$18.3 a mmBtu in the September quarter (See *Prices* section) and recovering oil prices.

Around three-quarters of Australian LNG is sold via long-term contracts that link the price of LNG to the price of oil with a lag of around three to six months, depending on contractual arrangements. LNG contract prices in the September quarter reflect Brent oil prices from the March (US$61 a barrel) and June (US$69 a barrel) quarters, which are considerably higher than corresponding quarters in 2020.

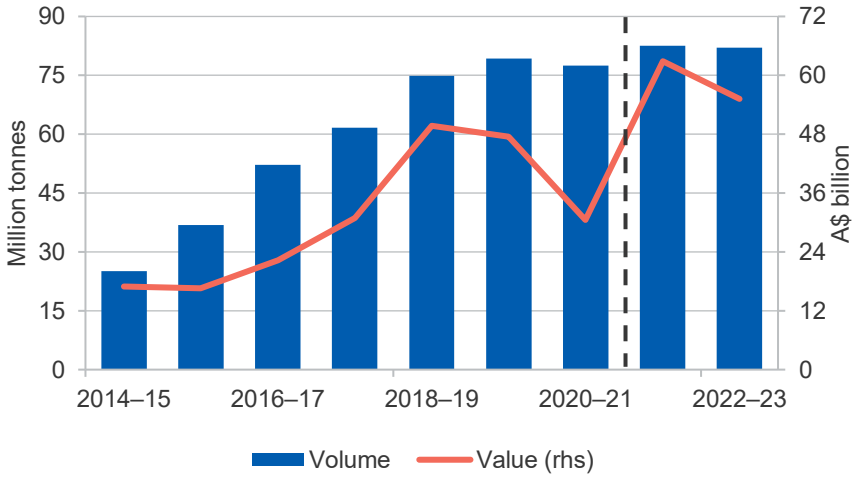
LNG export volumes expected to return to above pre-COVID-19 levels

With the resolution of major issues at both Gorgon and Prelude in the first half of 2021, export volumes are expected to recover in 2021–22 to exceed pre-COVID-19 levels, and then remain at about 94% of nameplate capacity. However, shutdowns at both Prelude and Gorgon late in the December quarter present a down-side risk to the volume forecasts, with considerable undertainty as to when the issues will be resolved.

Following a slower year for investment due to the COVID-19 pandemic, a number of FIDs have been announced in 2021. In January 2021, Santos announced a FID for an infill drilling program in the Bayu-Undan field. Production commenced in late July 2021, with initial outcomes better than expected. This program will extend output at the Darwin LNG facility, which was previously expected to halt production in 2022. This investment decision is expected to narrow the time between its depletion and the start-up of the Barossa backfill project. Santos announced a FID for Barossa on 30 March 2021, and is expecting initial gas production in the first half of 2025. Barossa is expected to extend the facility life of Darwin LNG by around 20 years.

Beach Energy inked a deal with BP Singapore to supply 3.45 million tonnes of LNG from the Waitsia gas project, processed through the NWS LNG facility, under a 5 year agreement to begin in 2023. The price structure is linked to both Brent and North East Asian spot prices, with downside price protection. It is meant to be one of the lowest cost LNG projects globally, competing on cost with the Qatari projects.

Figure 7.9: Australia's LNG exports



Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Woodside announced a FID on the Scarborough and Pluto Train 2 project on 22 November 2021.The Scarborough to Pluto LNG expansion — where a second gas processing train would be constructed, adding capacity of 5mtpa — is the only substantial expansion to Australia's LNG capacity in the investment pipeline. At $16.5 billion, this is the largest investment in Australia's upstream LNG capacity in over a decade.

According to Woodside, capacity utilisation at the NWS is expected to decline in 2022, as reserves at existing fields are depleted. NWS has secured short-term infill from Pluto (for the period 2022–2025) and Waitsia (for the period 2023–2028), which both have shorter lead times. However, large scale backfill projects are required for the longer term. Given the complex commercial arrangements associated with the NWS and high capital costs, there is potential for further backfill project delays. Browse is

earmarked as backfill to the NWS, but FID for this project has been deferred until at least 2023, citing weak market conditions.

After a strong first quarter, LNG exports are forecast to rebound to around 82 million tonnes in 2021–22. In 2022–23, Australian exports are expected to remain at around 82 million tonnes.

Higher prices expected to lift Australia's LNG export earnings

Australia's LNG export earnings fell sharply in 2020–21, down to $30 billion from $48 billion in 2019–20 (Figure 7.9). The majority of this decline was due to weak contract prices, particularly in the September and December quarters of 2020.

LNG export earnings are forecast to increase to $63 billion in 2021–22. Oil-linked contract prices are expected to be higher than pre-COVID-19 levels, and earnings will also be boosted by high Asian LNG spot prices. Export values in 2022–23 are forecast to be $55 billion, as export prices fall in line with oil prices and spot prices stabilise.

Uncertainty surrounds the next wave of investment

The outlook for the next wave of investment in Australian LNG projects improved in 2021, following a number of FID defferals in 2020 due to weak market conditions (see the *Resources and Energy Major Projects 2021* publication). Most LNG projects in the investment pipeline are backfill projects — required to support the ongoing operation of existing LNG facilities.

In the next few years, it is likely that at least one import terminal will be constructed and commence importing LNG. Five potential projects have been proposed, all concentrated in south eastern Australia. The Port Kembla LNG import terminal proposed by Australian Industrial Energy (AIE) has not achieved FID, but appears to be the most advanced of the five projects. AEMO's 2021 GSOO considers the project to be 'committed', with all necessary approvals in place to commence implementation. AIE has signed a project development agreement with Jemena to connect the terminal to the Eastern Gas Pipeline, and also recently signed an agreement with Norwegian firm Hoegh to supply the floating storage and regasification unit (FSRU). The terminal is expected to be operational by mid-2023. It is likely that only one LNG import terminal in south eastern Australia will be required in the short term (to 2027).

Revisions to the outlook

Australia's LNG export earnings have been revised up by $6.8 billion in 2021–22, and by $4.5 billion in 2022–23, reflecting higher assumed LNG spot prices and oil-linked contract prices.

Table 7.1: Gas outlook

						Annual percentage change		
World	**Unit**	**2020**	**2021[f]**	**2022[f]**	**2023[f]**	**2021[f]**	**2022[f]**	**2023[f]**
JCC oil price[a]								
– nominal	US$/bbl	45.3	68.5	72.5	69.2	51.0	5.9	-4.6
– real[h]	US$/bbl	47.0	68.5	70.1	65.2	45.6	2.4	-7.0
Asian LNG spot price[g]								
– nominal	US$/MMbtu	4.4	18.3	20.9	13.1	319.4	14.3	-37.3
– real[h]	US$/MMbtu	4.5	18.3	20.2	12.3	304.5	10.5	-38.9
Gas production[s]	Bcm	3,975	4,087	4,198	4,261	2.8	2.7	1.5
Gas consumption[s]	Bcm	3,969	4,125	4,199	4,261	3.9	1.8	1.5
LNG trade[ds]	Mt	356.3	365.3	391.6	397.2	2.5	7.2	1.4
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21[s]**	**2021–22[f]**	**2022–23[f]**
Production[b]	Bcm	157.6	151.7	160.4	160.4	-3.7	5.7	0.0
– Eastern market	Bcm	57.5	57.0	54.9	54.2	-0.9	-3.7	-1.3
– Western market	Bcm	85.7	80.8	89.9	90.7	-5.7	11.3	0.8
– Northern market[c]	Bcm	14.4	13.9	15.5	14.8	-3.5	11.8	-4.8
LNG export volume[d]	Mt	79.2	77.4	82.5	82.1	-2.3	6.5	-0.5
– nominal value	A$m	47,525	30,477	62,866	55,243	-35.9	106.3	-12.1
– real value[e]	A$m	49,465	31,215	62,866	54,076	-36.9	101.4	-14.0
LNG export unit value[g]								
– nominal value	A$/GJ	11.4	7.5	14.4	12.7	-34.4	93.7	-11.7
– real value[e]	A$/GJ	11.8	7.6	14.4	12.5	-35.4	89.1	-13.6
– nominal value	US$/MMBtu	8.1	5.9	11.1	10.0	-26.9	87.8	-9.4
– real value[h]	US$/MMBtu	8.4	6.0	11.1	9.8	-28.1	83.4	-11.3

Notes: **a** JCC stands for Japan Customs-cleared Crude; **b** Production includes both sales gas and gas used in the production process (i.e. plant use) and ethane. Historical gas production data was revised in the June quarter 2017 to align with Australian Petroleum Statistics; **c** Gas production from Bayu-Undan Joint Production Development Area is not included in Australian production. Browse basin production associated with the Ichthys project is classified as Northern market; **d** 1 million tonnes of LNG is equivalent to approximately 1.36 billion cubic metres of gas; **e** In 2021–22 Australian dollars; **f** Forecast; **g** 1 MMBtu is equivalent to 1.055 GJ; **h** In 2021 US dollars**; s** Estimate.
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021); Company reports; Nexant (2021) World Gas Model

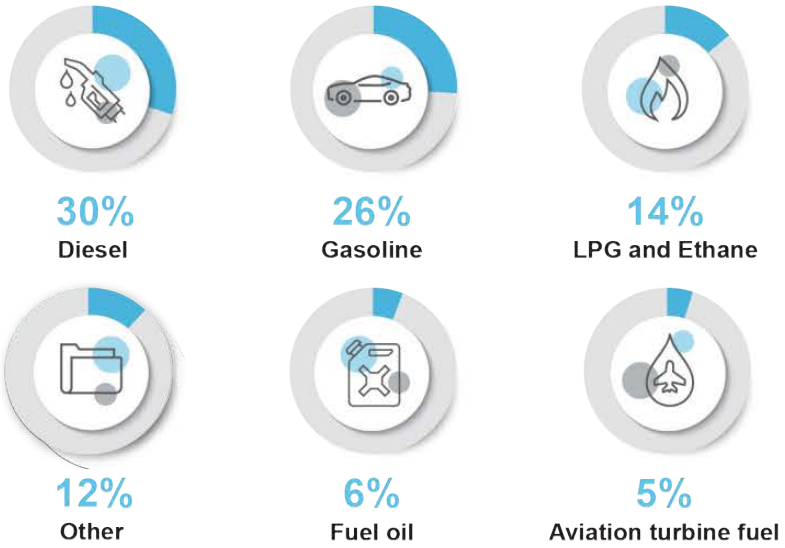
Oil

Australia's crude oil, condensate and LPG resources (PJ)

Oil facts

- Carnavon basin produces around **2/3 of Australia's crude & condensate**
- Over the last 5 years the Brent spot price ranged from US$17-$86 a barrel
- In 2020, around 29% of refinery feedstock was domestically produced.

World consumption

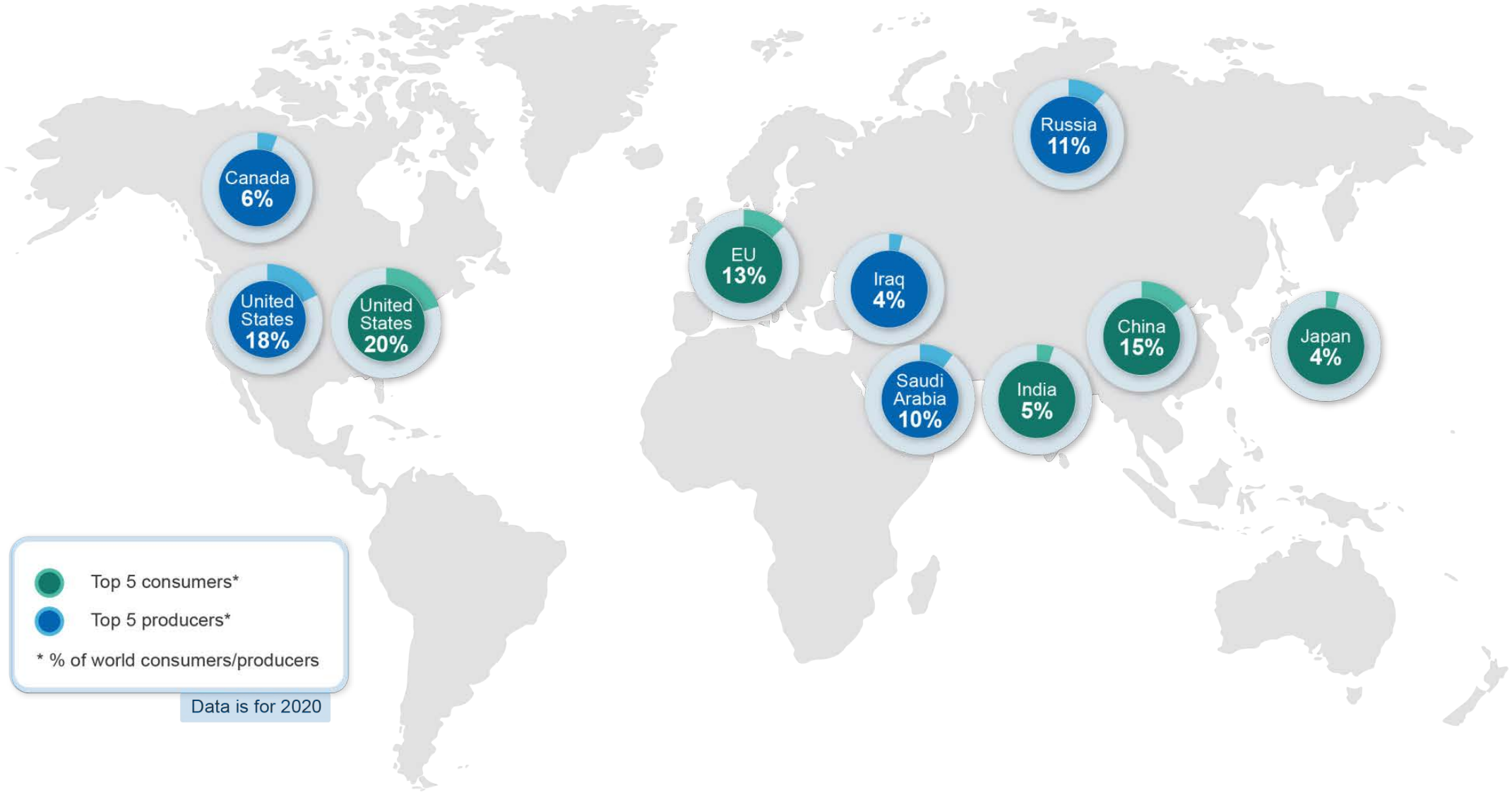


Australia's oil

- Holds **0.3%** of the world's **oil resources**
- In 2020-21 **oil exports** were worth **$7.4bn**
- Accounts for **0.3%** of **oil production**

Oil

Trade map | December 2021



8.1 Summary

- Oil prices are estimated to average US$70 a barrel in 2021 – a 66% increase from 2020. Recovering global consumption amid a tight market boosted prices, with a strong surge in the second half of the year. Brent crude prices are forecast to stabilise around $US70 a barrel over the forecast period.
- Australian crude oil and feedstock exports in 2021–22 are forecast to increase by 11% to 306,000 barrels a day, before returning to 300,000 barrels a day in 2022–23.
- High oil prices are expected to lift Australian oil export earnings by 69% to $12.6 billion in 2021–22. Earnings for 2022-23 are forecast to be $11.3 billion.

8.2 World consumption

Consumption on the path to recovery, but the pandemic remains a key risk

Global oil consumption in 2021 is estimated to have averaged 96 million barrels a day — a 5.7% increase from 2020, but 3.3% lower than 2019 levels. Consumption has been significantly impacted by the COVID-19 pandemic, with lockdowns and mobility restrictions affecting global industrial activity, commuting and leisure travel during the year. Eased containment measures in major oil consuming nations, alongside the continued rollout of vaccines, and rebound in economic growth, has aided strong overall demand growth in 2021. Global oil consumption in the September quarter 2021 surged by 2.6% compared to the June quarter 2021, and by 6.1% compared to the September quarter 2020.

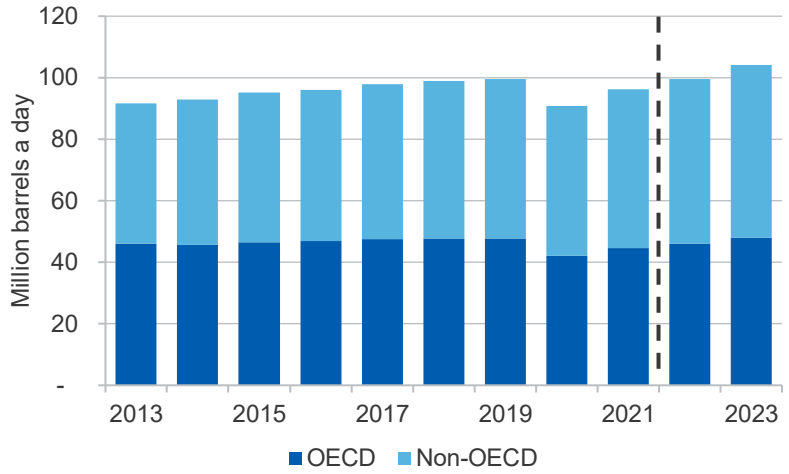
Demand for transport fuels is continuing to recover. Eased restrictions and strong vaccination programs in the US and Europe allowed for strong gains in road and aviation travel over the Northern Hemisphere summer holiday season this year, increasing fuel demand. Aviation fuel demand for China's domestic travel industry boomed for large periods in the year, although it was dampened by various COVID-19 outbreaks — which saw localised containment measures re-introduced in some provinces. The International Air Transport Association expects that global passenger traffic will not return to 2019 levels until 2024. By the end of November 2021, flight departures in the Eurocontrol area were roughly 76% of November 2019 levels, while departures in the US measured 89% of 2019 levels.

While vaccination programs are well underway globally — with major economies now even offering 'booster' shots — COVID-19 will continue to dominate as a downside risk to consumption over the outlook period. COVID-19 developments during the emergence of colder weather, including the upcoming Northern Hemisphere winter, are of particular concern for the recovery in demand for transportation and industrial fuels. At the time of writing, the detection of the Omicron strain had caused several nations to reintroduce international travel restrictions. The efficacy of available vaccines against the Omicron variant, and future COVID-19 strains, remains uncertain, as does the potential of renewed lockdowns and widespread travel restrictions. This will remain a key threat to recovery in global consumption in 2022, particularly for global jet fuel demand.

Industrial consumption has rebounded strongly this year, with sturdy growth in economic conditions aiding global petrochemical manufacturing. Consumption for the September quarter 2021 stabilised at close to pre-COVID-19 levels. Record natural gas prices (see *gas* chapter) in Europe and Asia over the last few months have triggered a growing interest in switching from gas to liquid fuels for industrial activities, as energy companies attempt to lower costs. If these trends continue, global demand for fuel oil, diesel and naphtha could surge in early 2022. An unseasonably cold Northern Hemisphere winter could boost this demand further.

In 2022, total world oil consumption is forecast to rise by 3.5% to 100 million barrels a day, aided by more positive economic outlooks, recovering mobility, and petrochemicals sector demand led by China and the US. Consumption is forecast to rise above pre-pandemic levels in 2023, to 102 million barrels a day, as global aviation demand strengthens (Figure 8.1).

Figure 8.1: Oil consumption, OECD and non-OECD



Source: Department of Industry, Science, Energy and Resources (2021); International Energy Agency (2021).

Improving mobility driving sustained consumption growth in OECD nations

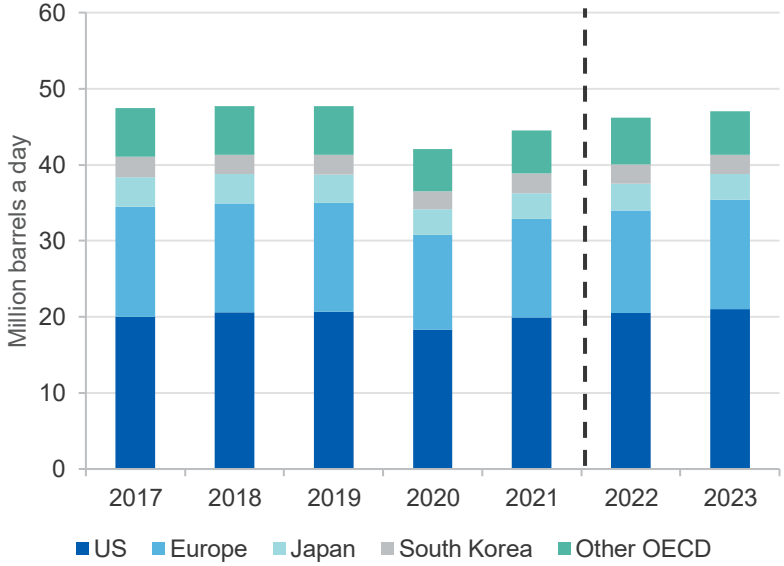
Despite weak outcomes early in the year, as a resurgence of COVID-19 infections limited demand for transport fuels in major nations, OECD oil consumption is swiftly recovering from the historic lows of 2020. Strong consumption gains occurred in the US and Europe between June and August 2021, as the easing of COVID restrictions resulted in more travel during the summer vacation season. Demand for gasoline and jet fuel remained strong in both regions well into the September quarter 2021.

A recovery in consumption in OECD Asia Pacific nations was hampered in the second half of the year by the surge in COVID-19 Delta variant cases, which forced Australia, New Zealand, Japan and South Korea to reimpose regional containment measures. However, Japan saw an uptick in industrial fuel consumption in the September quarter 2021, as well as some demand gains from the Summer Olympics. OECD demand in 2021 is estimated at 45 million barrels a day — a 6.0% increase from 2020, but a 6.7% decrease from pre-pandemic levels in 2019.

Strong COVID-19 vaccination rates and the availability of 'booster' injections in OECD nations should support continued positive growth in consumption. However, COVID-19 developments — including the reintroduction of any containment measures — remain a downside risk to the consumption forecast. By the end of November, infection rates in some European countries were again surging, with the possibility of introducing 'fourth wave' lockdowns in many nations, increasing.

Looking forward, consumption is forecast to increase by 3.7% to average 46 million barrels a day in 2022 and grow by a further 1.9% in 2023 (Figure 8.2). Beyond the outlook period, OECD consumption may never surpass 2019 levels, due to the improved fuel efficiency in passenger cars and increasing penetration of electric vehicles (EVs).

Figure 8.2: OECD total consumption, by major nations



Source: Department of Industry, Science, Energy and Resources (2021); International Energy Agency (2021).

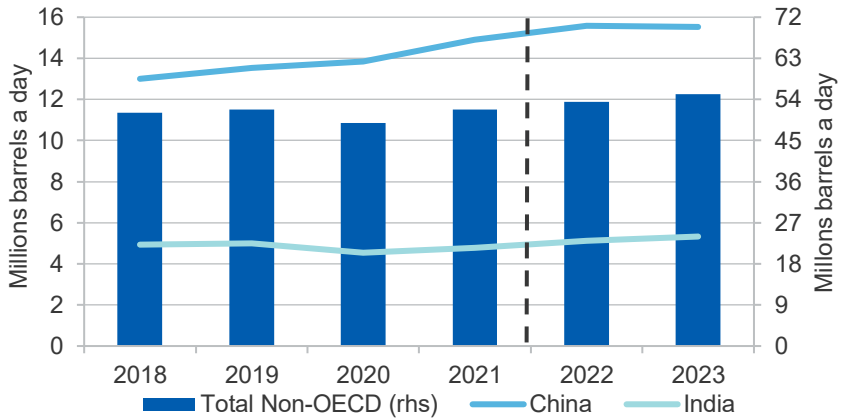
Non-OECD consumption is being driven by rising Chinese demand

Non-OECD consumption is estimated to have increased by 3 million barrels a day to average 52 million barrels a day in 2021.

Chinese oil usage recovered strongly in 2021, led by strong growth in gasoline, fuel oil and petrochemicals demand. Outbreaks of the COVID-19 Delta variant triggered widespread local containment measures in several Chinese provinces in early August and again in early November. The Chinese Government is maintaining a zero tolerance policy to COVID-19, in order to control outbreaks. These measures in August did not appear to affect industrial oil demand, however demand for jet fuel fell as a number of airports closed. Improving economic activity and vigorous policies to control future COVID-19 outbreaks should see demand in the world's second largest consuming nation continue to rise in 2022.

India has seen a significant recovery from its May 2021 COVID-19 Delta variant outbreak. By the September quarter 2021, infection control had improved, resulting in an easing of government restrictions on movement and a considerable recovery in road and aviation fuel demand. Mobility data for September 2021 reached 122% of pre-pandemic levels.

Figure 8.3: Non-OECD consumption



Source: Source: Department of Industry, Science, Energy and Resources (2021); International Energy Agency (2021)

While it is anticipated demand will continue to grow, strengthened by improving industrial activity, the pace of India's vaccination rollout and new COVID-19 variants provide heightened uncertainty to demand forecasts.

In 2022, non-OECD consumption is forecast to rise to 54 million barrels a day — surpassing 2019 pre-pandemic levels. The global shortages gripping coal and gas markets are likely to impact both China and India heading into 2022. This could see an even stronger fuel oil demand in early 2022, as power generators switch away from gas and coal. Demand is forecast to reach 55 million barrels a day in 2023 (Figure 8.3).

8.3 World production

Production set to ramp up in 2022

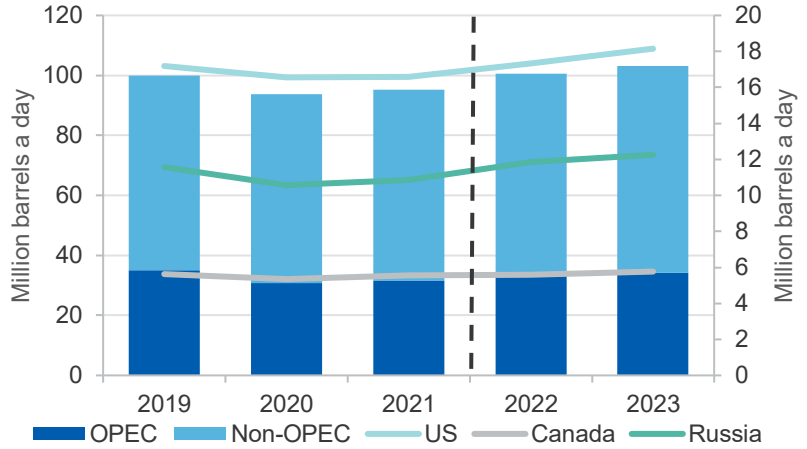
In 2021, global oil production is estimated to have risen by 1.5% compared to 2020 levels, to 95 million barrels a day, with the rise largely driven by gradual increases in OPEC+ output in the second half of the year. The supply approach of OPEC+ has achieved impressive drawdowns in global inventories — with OECD inventories plunging to their lowest levels since 2015.

Global supply is forecast to rise further in 2022 — with assumed increases in monthly oil output from OPEC+, and a ramp up in US shale production. A build in global inventories is likely to commence early in the year. Global production is forecast to increase by 5.6% to average 101 million barrels a day in 2022, before further increasing to 103 million barrels a day in 2023 (Figure 8.4).

OPEC+ supply progressively increasing

In response to a drastic surge in global oil inventories and plummeting prices in April 2020, OPEC+ reached an agreement to reduce production by 9.7 million barrels a day. Throughout 2020 and early 2021, OPEC+ compliance with output cuts was high, with the member countries that exceeded monthly quotas compensating with lower production in later months.

Figure 8.4: Global oil production



Notes: This assumes OPEC+ members fully comply with increased production quotas from August 2021.
Source: Department of Industry, Science, Energy and Resources (2021); International Energy Agency (2021).

Between May 2020 and July 2021, OPEC+ reduced their production cuts from 9.7 million barrels a day to 5.8 million barrels a day. On 18 July 2021, OPEC+ members announced they had reached an agreement for a significant winding back of the 2020 production cuts over the remainder of 2021 and into 2022. OPEC+ agreed to increase production every month — commencing in August 2021 — by 0.4 million barrels a day, until the cuts are eliminated by September 2022. The group agreed to meet monthly to reaffirm members' commitments to ensure adequate supply and maintain market stability. Since establishing the agreement, the group has remained cautious and has not adopted any changes, with the group citing the continued risks of the COVID-19 pandemic to global oil demand. This is despite calls from the US and other major consuming countries to boost supply more significantly in November and December 2021 amid surging energy prices.

OPEC+ has warned that increases in its production targets could result in the market becoming over supplied in early 2022. In September/October 2021, there were reports that the group did not meet the agreed target, as some nations — such as Nigeria and Angola — struggled to meet their quotas due to under-investment and operational issues in their upstream sectors. At their latest meeting on 2 December, OPEC+ agreed to continue with the 0.4 million barrel a day increase for January. However, the group will be closely monitoring pandemic and market developments and have stated they may make immediate adjustments if necessary before their next scheduled meeting on 4 January 2022. Results of these production decisions are a key source of global supply uncertainty.

The potential re-entry of Iran — which is currently exempt from output cuts — into the global oil market, would have a significant impact on world production. At the end of November 2021, international negotiations to revive the Joint Comprehensive Agreement Plan of Action resumed. At the time the deal was made in 2015, Iran's crude output rose by 1 million barrels a day over a 9 month period. These discussions will be a key factor to watch in 2022.

OPEC production is estimated to average 32 million barrels a day in 2021, up 2.4% from 2020. Assuming the July 2021 agreement is continued and production targets remain until September 2022, production is forecast to rise 6% to average 34 million barrels a day in 2022.

Non-OPEC production growing modestly

Output from non-OPEC nations is slowly being restored, with production estimated to have increased by 0.72 million barrels a day in 2021. Heavy maintenance programs to catch up on works delayed from 2020, as well as lengthy outages due to the difficult operating environment caused by COVID-19, have dampened production recovery this year.

After steep falls in 2020, US production is recovering more slowly than expected, despite the sector typically being highly responsive to prices. The modest recovery, even with the rise in oil prices, suggests US producers are taking precautions against the impact of renewed lockdowns. The US also endured a number of extreme weather events, further dampening recovery. Severe winter temperatures caused major disruptions to drilling operations in Texas in February. Hurricane Ida

passed through the Gulf of Mexico in late August. From 28 August through to 6 September, more than 80% of oil production in the Federal Offshore Gulf of Mexico (GOM) was shut in. By early October, greater than 95% of GOM supply was reported to be back online, with the remaining outages likely to last into early 2022.

It is expected that the post-Ida recovery will be supported by a ramp up in shale/tight oil production. Growth will come largely as a result of onshore operators increasing rig counts. In 2022, US output is forecast to rise by 4.5% to average 17 million barrels a day. While output is expected to rise, investment levels in the US shale sector remain a key concern. A shift towards upholding stronger Environmental, Social and Governance (ESG) values, amidst the Biden Administration's plans to address climate change, places downside risks on future output.

Other main drivers of non-OPEC supply growth in 2022 are anticipated to be Russia, Brazil, Canada and Norway. In 2022, non-OPEC production is expected to surpass pre-COVID-19 levels, averaging 67 million barrels a day, before rising to 69 million barrels a day in 2023.

8.4 Prices

Prices endured steep surge, followed by volatility, in second half of 2021

Oil prices have seen a tremendous upwards trajectory in 2021, following the dramatic falls in the first half of 2020. An uptick in global demand amid recovering economic activity, a disciplined approach from OPEC+, and a lagged recovery from other major producers, has facilitated stock draw downs and boosted prices. The average Brent oil price in January was US$55 a barrel, but by November prices had surged to average US$81 a barrel. Prices dipped in early April, as some countries (such as India) reimposed COVID-19 containment restrictions, and fluctuated again in August, when a surge in the Delta variant COVID-19 cases gripped the globe. The rise was particularly steep between September and November, with prices topping US$85 a barrel on multiple days in October and November. These were the highest levels recorded since October 2018. During November 2021, price volatility increased, as a surge in new Delta variant outbreaks prompted the governments of some European nations to reinforce containment measures. China also reported its largest outbreak caused by the Delta variant in November, with the Chinese Government introducing localised restrictions. On November 26, with the news of the detection of the Omicron variant, prices plunged. Brent crude dropped 12% to US$72 a barrel. The average Brent price for the December quarter is estimated at US$79 a barrel. Overall, Brent oil prices are estimated to have averaged US$70 a barrel in 2021 — a 66% increase from last year (Figure 8.5).

The sharp price rise seen in the second half of 2021 is the result of a number of significant global market developments. Crude oil prices have been swept up in the broader energy market rally, where high gas and thermal coal prices (see *gas* and *coal* chapters) in Europe and Asia have prompted interest in gas-to-oil fuel switching for power generation. This potential increase in demand comes in addition to the ongoing recovery in oil consumption linked to the global economic recovery. Global supply has remained tight, following supply disruptions in US offshore crude production in the wake of Hurricane Ida, and the high compliance with output cuts among OPEC+ members. The tight market has facilitated sustained draws of global inventories. From May to September, total OECD oil stocks were drawn by nearly 170 million barrels.

In November 2021, the US Government announced it will release 50 million barrels of oil from its Strategic Petroleum Reserves (SPR), in coordination with China, India, South Korea, Japan and the United Kingdom. Of the 50 million barrels, 32 million barrels be an exchange delivered from mid-December through April 2022 that will eventually return to the SPR in the years ahead. 18 million barrels will be an acceleration of a sale of oil that was previously authorised by the US Congress. The SPR release was designed to alleviate rising local gasoline prices, with the average U.S. regular gasoline retail price in October at its highest monthly average since September 2014. Speculation of the announcement led to some decline in global prices in the weeks prior to it being formally announced.

Figure 8.5: Brent oil prices in 2020 and 2021

Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021).

Brent prices forecast to average US$73 a barrel in 2022

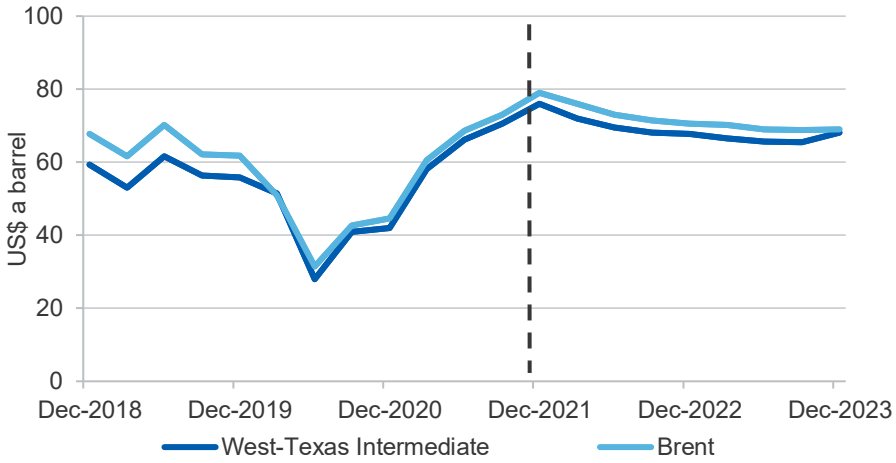
Developments concerning the Omicron variant, as well as the SPR release and any change in output decisions of OPEC+, could result in oil prices remaining somewhat volatile heading into 2022. However, considering the observed market shifts when outbreaks of the Delta variant occurred in 2021, and some recovery in early December, it is anticipated that prices will rebuild some of their losses in early 2022. As 2022 progresses, consumption is expected to grow. Production is also forecast to lift, with both a rise in output from the US and forecast monthly output increases from OPEC+. It is anticipated that these market shifts will help to rebuild global oil stocks and put gradual downward pressure on prices. The release from the SPR will increase domestic supplies in the US, and so could result in a

In 2022, Brent prices are forecast to average US$73 a barrel (Figure 8.6).

COVID-19 developments, including new virus variants, will continue to provide demand side uncertainty and affect market sentiment over the forecast period. At the time of writing, the Omicron variant was surfacing in major nations and causing volatile behaviour in oil prices, as the threat of renewed lockdowns and restrictions on mobility weighed on market sentiment. While it is anticipated that global consumption will continue on an upward trajectory throughout 2022, the effectiveness of vaccines against new virus strains, along with government responses when new outbreaks occur, has strong potential to impact global demand and affect prices. The slower pace of vaccine deployment in emerging economies heightens the possibility of additional restrictions in response to outbreaks. Pandemic related uncertainty will be a key factor to observe over the outlook period.

On the supply-side, price forecast uncertainty is largely driven by the production decisions of OPEC+. Given an evolving demand outlook, with risks posed by pandemic, the group could make major adjustments to production targets, thus affecting future output. Additional uncertainty exists beyond September 2022, when the current agreement for production quotas is due to end. It is expected that US producers will ramp up drilling activity in response to the price recovery in 2021.The increased US output will impact future prices.

Figure 8.6: Price outlook



Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021).

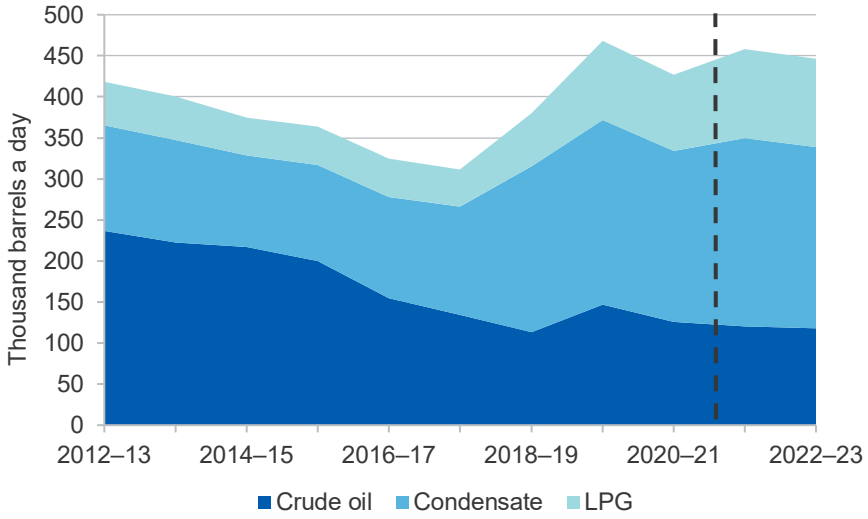
8.5 Australia

Project investment decisions to influence future production

In 2020–21, Australian crude and condensate production declined to 334,000 barrels a day — a 10.1% decline from 2019–20 (noting that source data for Australian production has been revised– see *historical data tables*). Condensate output was negatively impacted when the Prelude FLNG project was offline from February 2020 to January 2021. Gorgon also experienced a number of technical issues throughout 2020 and early 2021, further disrupting production. Issues at Gorgon were resolved at the end of July, so output is likely to lift in 2021–22. In 2020–21, condensate accounted for 49% of total Australian crude oil, condensate and LPG production. LPG accounted for 22% (Figure 8.7).

Production is forecast to increase to 349,000 barrels a day in 2021–22, as output recovers at existing major fields and projects. Output is expected to return to 339,000 barrels a day in 2022–23.

Figure 8.7: Composition of Australian oil production



Source: Australian Bureau of Statistics (2021); Department of Industry, Science, Energy and Resources (2021)

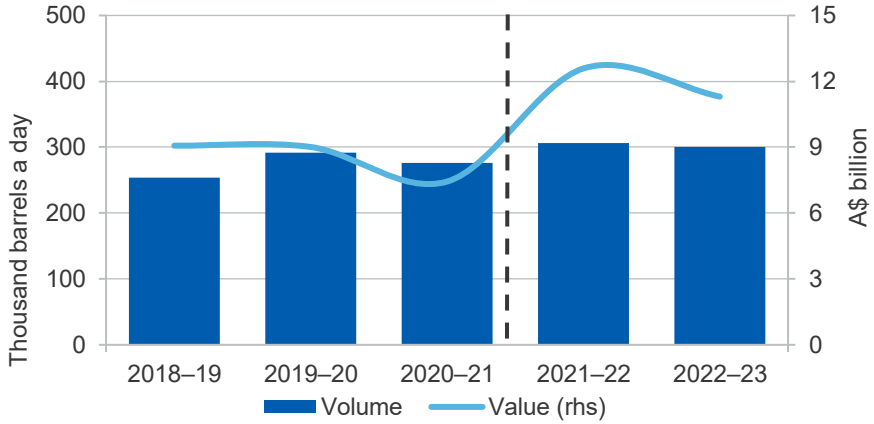
Final Investment Decisions (FIDs) for several large oil and gas projects expected in the coming year, may affect crude, condensate and LPG production beyond the forecast period (see *Resources and Energy Major Projects: 2021 Report*).

Santos is anticipating an FID on the Dorado oil project in the Bedout sub-basin off the coast of Western Australia, in 2022. This project has an estimated initial capacity of 75–100k barrels a day — nearly a quarter of 2020–21 Australian crude oil and condensate production. In June 2021, Santos announced the project had entered the front-end engineering and design (FEED) phase. First production is expected by 2026.

Australian export earnings to lift with higher prices

Australian crude and condensate export values were $7.4 billion in 2020–21. Export values declined by 17.5% from 2019–20, reflecting the weak prices experienced in 2020. The surge in prices in 2021 is expected to lift export earnings in 2021–22. Crude and condensate export values are forecast to rise to $12.6 billion in 2021–22, before decreasing in 2022–23 to $11.3 billion, as prices decline and stabilise (Figure 8.8).

Figure 8.8: Australian oil and feedstock exports



Notes: Includes crude oil and condensate, but excludes LPG.
Source: Australian Bureau of Statistics (2021); Department of Industry, Science, Energy and Resources (2021).

Domestic refinery production falling with refinery closures

Australian refinery output declined by 15.8% in 2020–21 (noting that source data for Australian production has been revised– see *historical data tables*). Local refiners suffered a challenging year — with low transport demand and fierce international competition weighing on profitability. In the space of four months, half of Australia's refineries announced they would close in 2021.

BP decommissioned their Kwinana refinery in March 2021 to convert it to an import terminal. Exxon Mobil commenced the shutdown process for their Altona refinery at the end of August 2021. The two remaining refineries — — continue to operate until at least mid-2027, subject to Government support. As part of the 2021–22 Budget, the Australian Government announced a comprehensive fuel security package. The package includes a variable fuel security services payment to the remaining refineries, where they will receive payment for the production of key transport fuels (jet fuel, petrol and diesel). A minimum stockholding obligation (MSO) is also included in the package, and will require importers and refiners in Australia to maintain minimum stocks of key transport fuels from 1 July 2022.

Total refinery production in September 2021 fell 17% compared to the previous month, as refinery operations wound down at Altona. With only two remaining refineries producing the majority of Australia's key fuels, refinery throughput will likely continue to decline in 2021–22 and 2022–23.

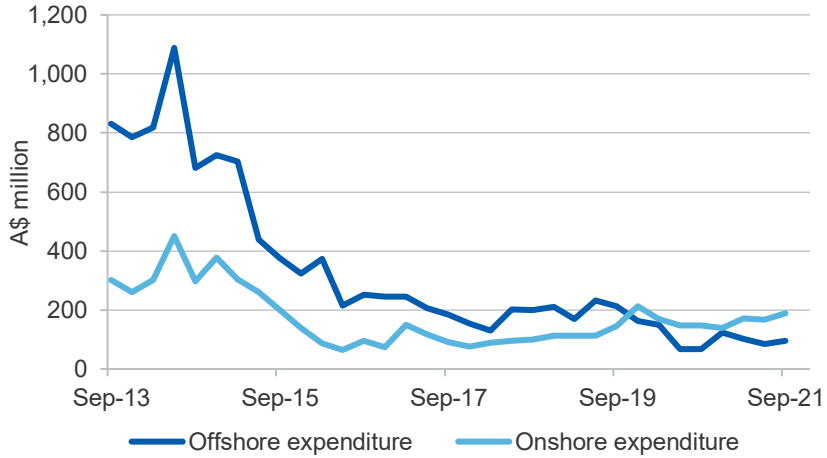
Australian refined product consumption fell in 2020–21, as COVID-19 containment measures continued to weigh on activity. Aviation fuel consumption decreased by 54% from 2019–20 levels, reflecting the effects of COVID restrictions on both domestic and international travel. However, diesel consumption for 2020–21 was 2% higher than in 2019–20, owing to its broad consumption base. Between June and September 2021, overall consumption steadily declined, due to falls in automotive gasoline and aviation fuel consumption. The fall in demand for refined products reflects lockdowns in NSW, VIC and the ACT during these months. Australia's strong vaccination campaign, the re-opening of most state borders, and eased international border restrictions, are expected to strengthen demand for transportation fuels in 2022.

Australian refined product usage is forecast to recover in 2021–22 from 2020–21 levels. However, consumption gains will be constrained by the south east coast state lockdowns of most of the second half of 2021.

Exploration

In the September quarter 2021, Australia's petroleum exploration expenditure was $285 million on a seasonally adjusted basis — a quarterly increase of $32.8 million or 13%. Onshore exploration rose 13% to $189 million, while offshore increased by 14% to $96.2 million (Figure 8.9).

Figure 8.9: Australian petroleum exploration



Source: ABS (2021) Mineral and Petroleum Exploration, Australia, 8412.0.

Revisions to forecasts

Since the September 2021 *Resources and Energy Quarterly*, the forecast for Australia's crude and condensate export earnings has been revised up by around $1.40 billion in 2021–22, due to higher prices. Export earnings for 2022–23 have been revised up by $1.37 billion.

Table 8.1: Oil Outlook

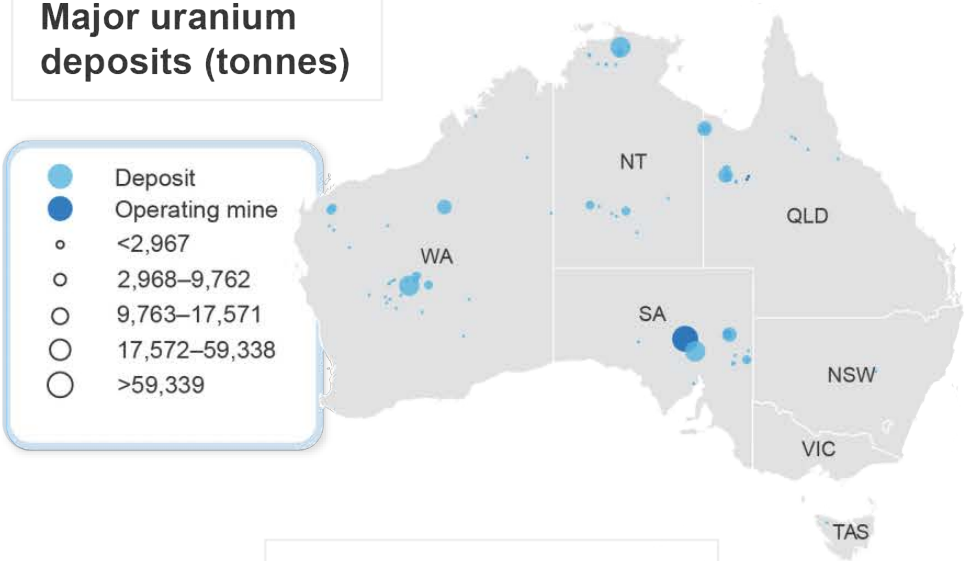
World	Unit	2020	2021[s]	2022[f]	2023[f]	Annual percentage change 2021[s]	2022[f]	2023[f]
Production[a]	mb/d	93	95	101	103	2.4	5.6	2.4
Consumption[a]	mb/d	91	96	100	102	5.7	3.5	2.6
WTI crude oil price								
– nominal	US$/bbl	41	68	69	66	67.0	2.4	-4.2
– real[b]	US$/bbl	42	68	67	63	61.0	-1.0	-6.7
Brent crude oil price								
– nominal	US$/bbl	42	70	73	69	65.6	3.5	-4.9
– real[b]	US$/bbl	44	70	70	65	59.7	0.1	-7.4
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Crude and condensate								
Production[ac]	kb/d	372	334	349	339	-10.1	4.5	-2.9
Export volume[a]	kb/d	291	276	306	300	-5.2	10.8	-1.8
– Nominal value	A$m	9,009	7,434	12,586	11,303	-17.5	69.3	-10.2
– Real value[h]	A$m	9,377	7,614	12,586	11,064	-18.8	65.3	-12.1
Imports[a]	kb/d	317	247	196	200	-22.2	-20.5	2.1
LPG production[acd]	kb/d	96	92	108	107	-4.4	17.7	-1.3
Refined products								
– Refinery production[ac]	kb/d	445	375	250	236	-15.8	-33.3	-5.5
– Export volume[ae]	kb/d	17	13	12	11	-21.4	-9.5	-4.2
– Import volume[a]	kb/d	640	647	725	762	1.1	12.0	5.2
– Consumption[acg]	kb/d	981	913	880	910	-7.0	-3.5	3.4

Notes: **a** The number of days in a year is assumed to be 365, and a barrel of oil equals 158.987 litres; **b** In 2021 calendar year US dollars; **c** Historical production data was revised in the December quarter 2021 to align with Australian Petroleum Statistics.**d** Primary products sold as LPG; **e** Excludes LPG; **f** Forecast; **g** Domestic sales of marketable products, including imports; **h** In 2020-21 financial year Australian dollars; **s** estimate.

Source: ABS (2021) International Trade in Goods and Services, Australia, Cat. No. 5368.0; International Energy Agency (2021); EnergyQuest (2021); US Energy Information Administration (2021); Department of Industry, Science, Energy and Resources (2021).

92 U 238.029 Uranium

Major uranium deposits (tonnes)



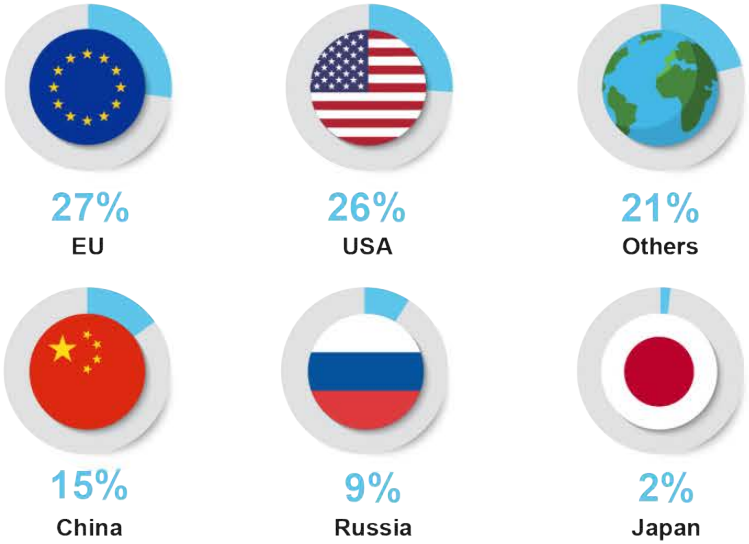
Uranium facts

Originally formed in supernovae more than **6 billion years ago**

Nuclear plants can supply electricity to **4-5 million people**

Nuclear has among the **lowest death and accident rates** of any power source

Consumer markets



Australia's Uranium

Ranked no 1 for **uranium resources**

3rd largest uranium producer in the world

Exports worth more than **$400m**

9.1 Summary

- Investor demand has seen uranium prices lift in recent months, and further modest growth is expected over the forecast period. Prices are forecast to lift from US$30 a pound in 2020 to US$47 a pound by 2023.
- Australian production is forecast to decline from 2021, as the number of active uranium mines falls from three to two (see *Australia section*).
- Price growth is expected to see uranium export values increase from $582 million in 2020–21 to $623 million by 2022–23.

9.2 World consumption

More countries are showing interest in nuclear reactors

Nuclear power use continues to diversify: China, South Korea and Russia are all expected to bring new plants online by 2024. But development also continues in a range of other countries (Figure 9.1 and 9.2).

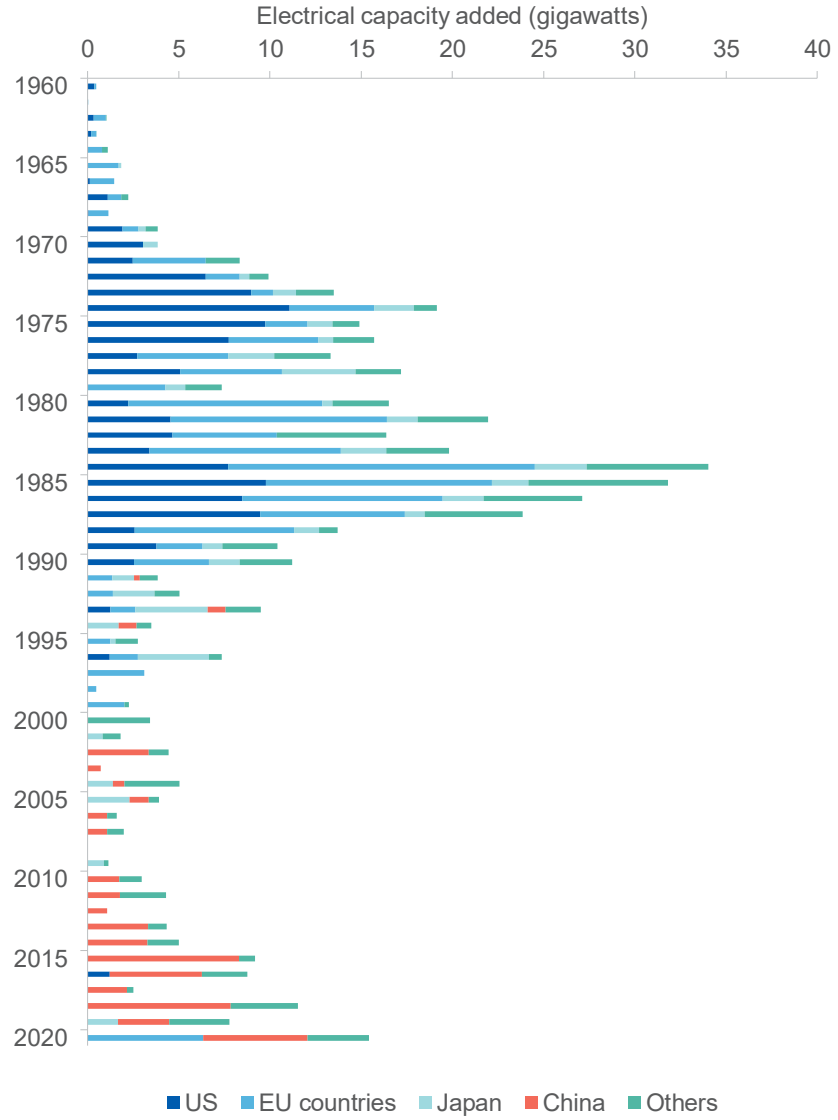
Work has finished on the third plant of the UAE's Barakah nuclear facility, with commercial operation expected to commence in 2023.

Nuclear Power Ghana — a body set up to oversee the country's first nuclear plant — has released a new timetable, which calls for a choice of vendor by 2025, and for generation to start from 2030. In South Africa, the cabinet has approved the country's new Multipurpose Reactor, which will produce radioisotopes. South Africa's energy regulator has also approved a ministerial determination to add 2500 MWe of new nuclear capacity for electricity generation, more than doubling existing capacity.

In South Asia, Bangladesh has announced plans to build a second nuclear plant once construction has concluded on its initial Rooppur plant.

In Eastern Europe, the Romanian government has announced plans to double its nuclear power supply, with two new CANDU reactors to be installed at Cernavoda by 2031. In Bulgaria, rising gas prices have generated strong profits for the country's Kozloduy nuclear plant, which produces electricity at a relatively low cost. Profits generated at the plant are being used to provide energy subsidies to industries affected by high LNG prices.

Figure 9.1: Growth in world nuclear power generation



Source: International Energy Agency (2021); World Nuclear Association (2021); Department of Industry, Science, Energy and Resources (2021)

The UK Government has confirmed that nuclear power will play a key role in its net zero emissions target. The Government has announced that up to GBP1.7 billion will be provided to fund a new nuclear power plant. This follows the recent passage of the Nuclear Energy (Financing) Bill, which seeks to attract private investment to new plants by cutting finance costs. In France, where most power generation comes from nuclear plants, President Macron has formally announced that new reactors will be built in order to improve energy security and reduce emissions.

Small modular reactors continue to develop. The US Air Force has announced plans for a micro reactor in Alaska by 2027. NuScale Power and Nuclearelectrica plan to build a small modular reactor in Romania by 2028. In China, steel containments have been laid for the ACP100 demonstration project, which the China National Nuclear Corporation describes as the world's first commercial small modular reactor.

On balance, uranium consumption is expected to edge down by 0.8% in 2022 and up by 1.1% in 2023, with growth picking up in subsequent years as a growing number of countries expand or commence their investment in nuclear power.

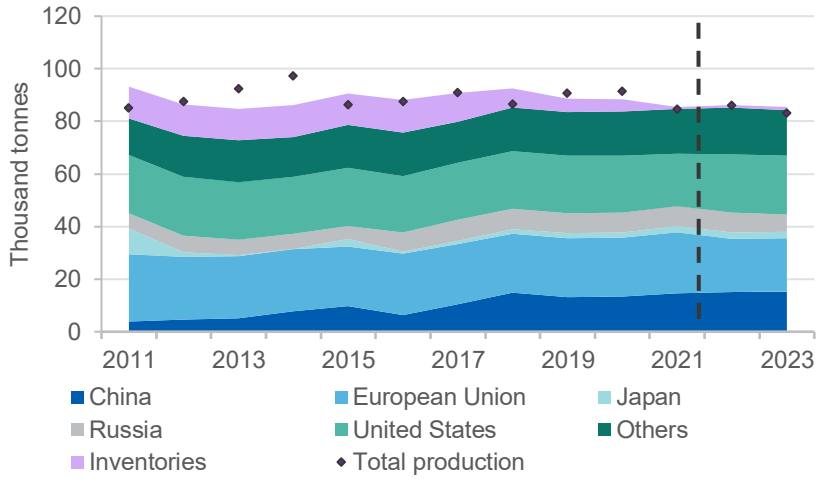
9.3 World production

Large suppliers are shifting back to full production

Utility requirements remain relatively modest, and are not expected to grow much over the next 12-18 months. Global supply remains constrained (Figure 9.3), but with potential to expand given large producers in Kazakhstan and Canada have not yet returned to full capacity. Price growth over the last few months may also encourage new mines, which have been in short supply. Among the first will be Dobrovolnoye in Russia, where operations are expected to begin in 2022.

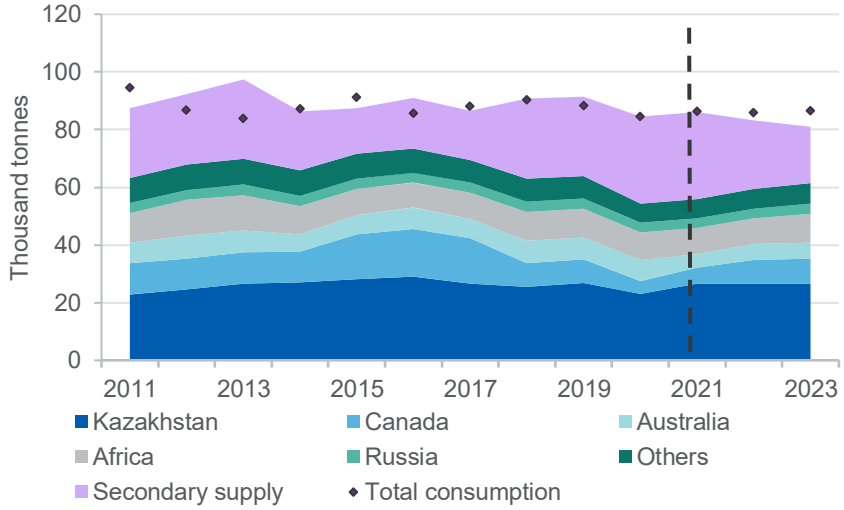
Work is being done to tap the potential of used nuclear fuel. Scientists in Slovenia and the UK have released research showing that radiation from nuclear fuel can be used to help create biodiesel, which is used as renewable fuel in a wide array of engines. This could potentially lead to greater re-use of nuclear fuel over the longer term.

Figure 9.2: World uranium consumption and inventory build (U3O8)



Source: International Energy Agency (2021); World Nuclear Association (2021); Ux Consulting (2021)

Figure 9.3: World uranium production and secondary supply (U3O8)



Source: International Energy Agency (2021); World Nuclear Association (2021); Ux Consulting (2021)

9.4 Prices

Prices are expected to rise slowly over the outlook period

Uranium prices have lifted in recent months, supported by greater investor interest in the uranium spot market. This has been driven in part by the commencement of a new purchase program started by the Sprott Physical Uranium Trust, which has significant funds to deploy. Supply to the spot market remains relatively contained, with the result that investor interest has lifted spot prices relative to contract prices.

Recent price gains are thus largely speculative and subject to downside risks. However, prices are expected to move to a firmer footing as utility demand rises towards the end of the outlook period (Figure 9.4).

9.5 Australia

Production and exports are set to decline in the short term

Australia's uranium exports have dropped since the closure of ERA's Ranger mine. However, approval of Vimy Resources' Mulga Rock project by the Western Australian Department of Mines, Industry Regulation and Safety may support future output, with the mine expected to start in 2025.

The Australian Nuclear Science and Technology Organisation has progressed with plans to construct a nuclear medicine manufacturing facility at Lucas Heights. An existing facility at the same site produces 10,000 to 12,000 doses of nuclear medicine each week, and output at the new facility is expected to increase output from this level.

Exploration spending rose to $5 million in the September quarter (compared to $1.8 million a year ago), suggesting prices and potential supply shortages are building interest in new deposits. Uranium export earnings are expected to fall by 13% in 2021–22, before recovering in 2022–23 as prices rise (Figure 9.5). Export volumes are expected to lift by 13% in 2022–23 as output recovers at Olympic Dam.

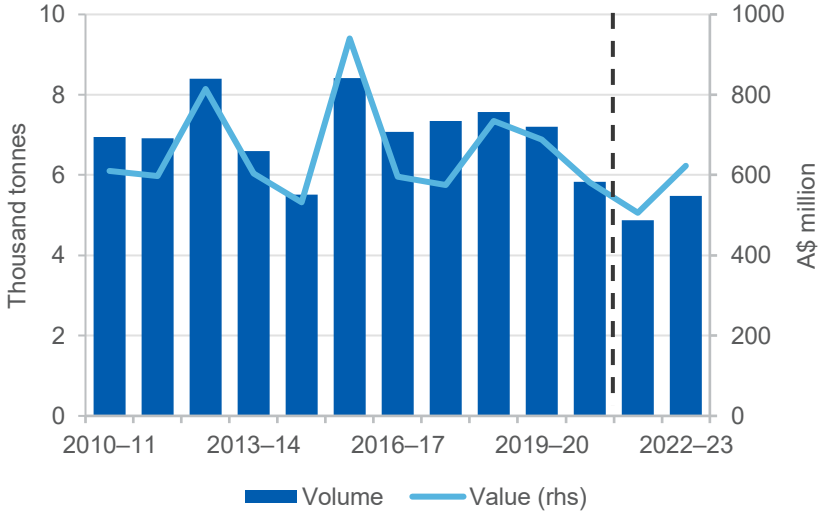
Revisions to the outlook

Export earnings have been revised up by around $80 million for 2022–23, reflecting recent price gains. Other forecasts are largely unchanged.

Figure 9.4: Uranium price outlook

Source: Cameco Corporation (2021) Uranium Spot Price; Ux Consulting (2021) Uranium Market Outlook

Figure 9.5: Australia's uranium exports



Source: Department of Industry, Science, Energy and Resources (2021)

Table 9.1 Uranium outlook

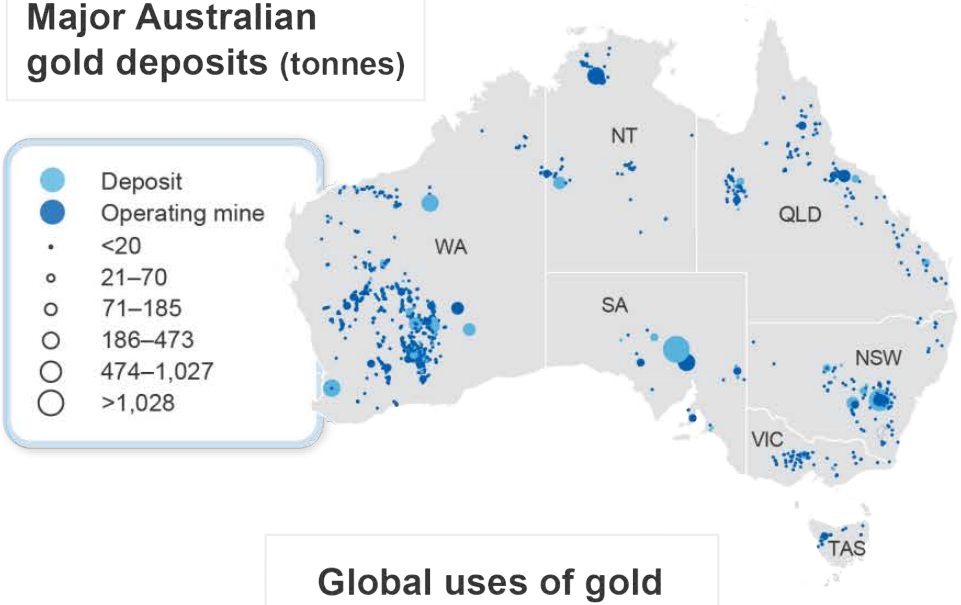
						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021**	**2022[f]**	**2023[f]**
Production	kt	54.4	56.0	59.4	61.4	2.8	6.2	3.3
Africa[b]	kt	9.6	9.1	8.9	10.0	-5.2	-1.8	12.4
Canada	kt	4.8	5.4	8.2	8.6	14.3	50.0	5.0
Kazakhstan	kt	22.7	26.6	26.6	26.6	17.6	0.0	0.0
Russia	kt	3.4	3.3	3.3	3.7	-3.2	0.0	12.2
Consumption	kt	84.1	85.5	84.8	85.7	1.7	-0.8	1.1
China	kt	13.5	14.7	15.1	15.2	8.9	2.6	1.1
European Union 27	kt	22.4	23.1	20.3	20.3	3.2	-12.4	0.1
Japan	kt	1.9	2.4	2.4	2.4	26.0	0.0	0.0
Russia	kt	7.4	7.6	7.6	6.8	2.6	-0.6	-10.6
United States	kt	21.7	19.8	22.0	22.2	-8.6	11.5	0.7
Spot price	US$/lb	30.0	35.5	46.1	47.4	18.6	29.8	2.8
real[c]	US$/lb	31.1	35.5	44.6	44.6	14.4	25.5	0.1
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[ff]**	**2022–23[f]**	**2020–21[f]**	**2021–22[f]**	**2022–23[f]**
Mine production	t	7,348	6,213	4,871	5,480	-15.4	-21.6	12.5
Export volume	t	7,195	5,830	4,871	5,480	-19.0	-16.4	12.5
– nominal value	A$m	688	582	506	623	-15.4	-13.1	23.2
– real value[d]	A$m	716	596	506	610	-16.7	-15.2	20.6
Average price	A$/kg	95.6	99.9	103.9	113.7	4.4	4.0	9.5
– real[d]	A$/kg	99.5	102.3	103.9	111.3	2.8	1.5	7.2

Notes: **b** Includes Niger, Namibia, South Africa, Malawi and Zambia; **c** In 2021 US dollars; **d** in 2020–21 Australian dollars; **s** estimate; **f** forecast;
Source: Department of Industry, Science, Energy and Resources (2021); Cameco Corporation (2021); Ux Consulting (2021) Uranium Market Outlook

79
Au
196.967

Gold

Major Australian gold deposits (tonnes)



Gold

Approx 187,200 tonnes of gold mined since the **beginning of civilisation**

The US Federal Reserve holds **6,700 tonnes of gold**

Gold makes up **3 parts per billion** of the Earth's outer layer

Global uses of gold

37%
Jewellery

24%
Coins and bars

23%
Gold-backed exchange traded funds

8%
Electronics, industrial, dental and medical

8%
Central bank reserves

Australia's gold

World's no. 1 producer of gold in first-half of **2021**

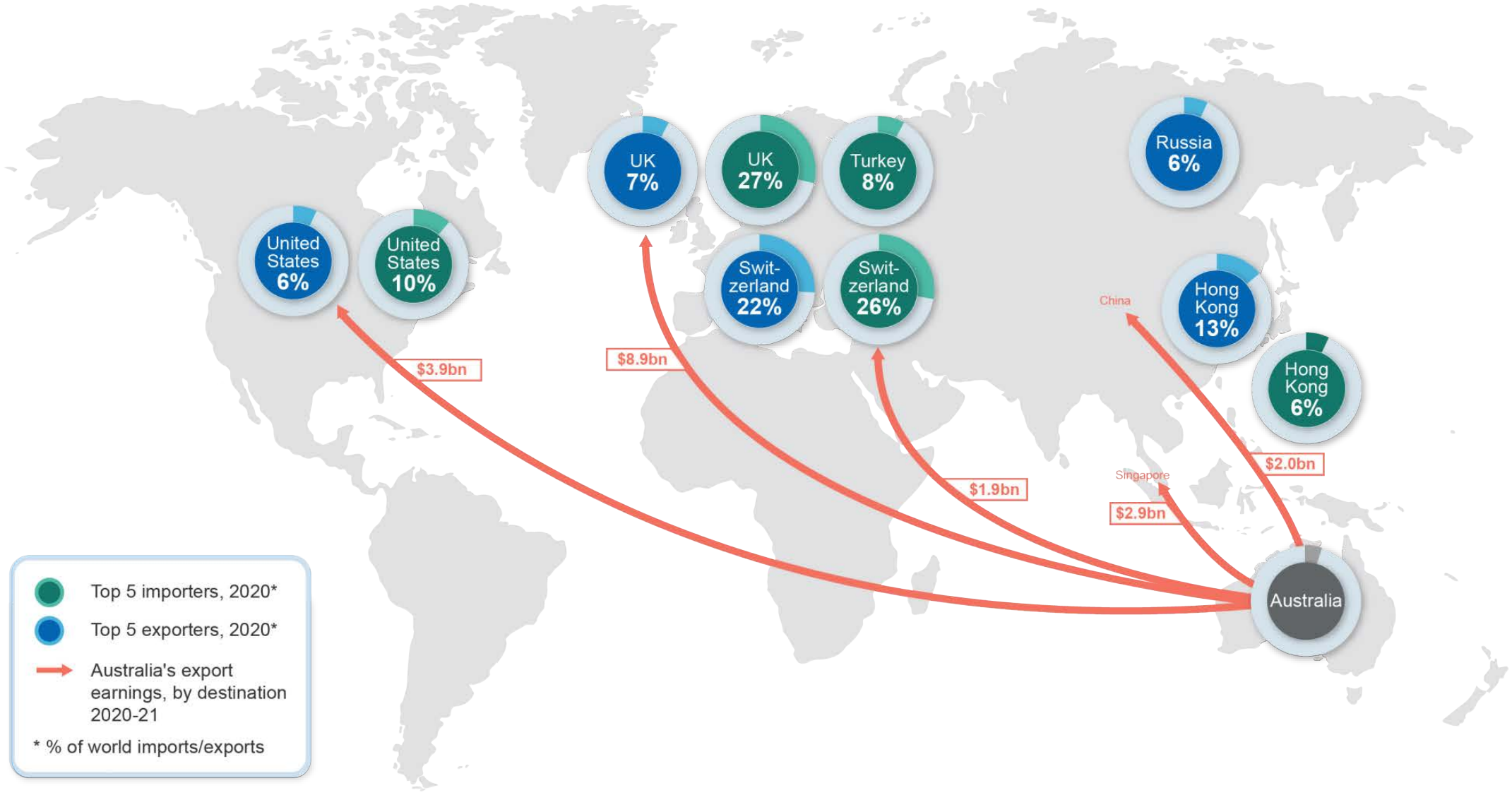
World's largest reserves of gold

World record holder for **largest gold nugget** 72kg

79 Au 196.967

Gold

Trade map | December 2021



10.1 Summary

- The gold price is estimated to have increased by 1.8% in 2021 to US$1,800 an ounce. A higher real interest rate environment is likely to see the gold price slide to around US$1,700 an ounce in 2023.
- Labour and skills shortages are affecting Australian gold mine production, which is forecast to reach 362 tonnes in 2021–22. Production from new mines and existing mine expansions is expected to boost gold mine production to 374 tonnes in 2022–23 (see Australia section).
- Australia's gold export earnings are forecast to increase from $28.3 billion in 2021–22 to $28.4 billion in 2022–23, driven by higher export volumes (to 377 tonnes in 2022–23).

10.2 Consumption

World gold consumption decreased in the September quarter 2021

World gold demand decreased by 7.0% year-on-year to 831 tonnes in the September quarter 2021, led by a strong outflow from gold-backed exchange traded funds (ETFs). Over this period, investors pulled out 27 tonnes (worth US$1.6 billion) of gold from gold-backed ETFs. An improvement in the global economy and the COVID-19 vaccine roll-out led to an exodus of institutional investors' funds from safe haven assets (such as gold ETFs) to riskier assets. Global stock markets continued to reach record highs in the September quarter 2021, attracting investment funds.

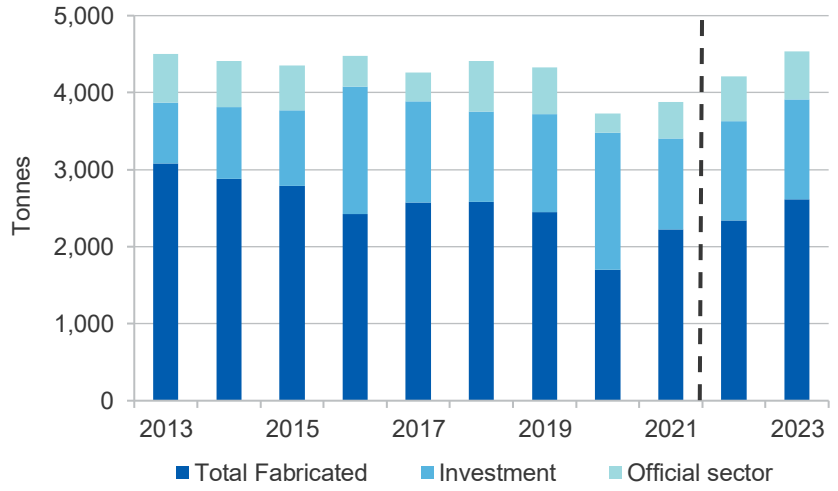
Offsetting the fall in gold-backed ETFs in the September quarter 2021 was a modest addition (69 tonnes) of official gold buying (that is, from central banks and other government financial institutions) (Figure 10.1). A desire to diversify reserves, growing debt levels and rising inflation were the catalyst for central banks' growing appetite towards gold. According to the World Gold Council, India and Brazil were the largest gold buyers in the September quarter 2021, purchasing 50 tonnes of gold. Turkey and Qatar were the largest gold sellers in the September quarter 2021, selling 16 tonnes of gold.

Over the year to the September quarter, jewellery demand rose by 33% year-on-year to 443 tonnes, led by a 32% (or 157 tonnes) rise in consumption in China (excluding Hong Kong) and a 58% (or 96 tonnes) rise in consumption in India — the world's two largest gold jewellery consuming nations. The recovery of the Chinese and Indian economies were the main contributing factor to China and India increasing jewellery demand in the September quarter 2021.

In the US, led by the economic recovery and improved consumer sentiment, jewellery consumption increased by 12% year-on-year to 32 tonnes in the September quarter 2021.

Jewellery consumption in several Asian countries was disrupted by extended COVID-19 lockdowns, including Vietnam (down by 50% year-on-year to 0.9 tonnes in the September quarter) and Malaysia (down by 48% year-on-year to 1.3 tonnes in the September quarter).

Figure 10.1: World gold consumption by sector



Note: Total fabricated includes jewellery consumption and industrial applications
Source: World Gold Council (2021) Gold Demand Trends; Department of Industry, Science, Energy and Resources (2021)

Demand for gold bars and coins also grew strongly in the year to the September quarter 2021 (up 19% or 41 tonnes year-on-year). Growth in gold bar and coin retail investment was propelled by a 12% (or 6.9 tonnes) year-on-year rise in China's bar and coin demand. Encouraged by lower gold prices and rising incomes, Chinese retail investors stepped up their purchases in anticipation of short to medium term gains.

World gold consumption forecast to rise in 2021

World gold consumption is estimated to increase by 4.0% to 3,880 tonnes in 2021 (Figure 10.1), as the ongoing economic recovery provides some support for jewellery demand.

In 2021, jewellery demand is estimated to have rebounded strongly from the heavy reduction in 2020, up 34% year-on-year, to 1,885 tonnes. China and India are expected to have contributed the most to this recovery. Lower and more stable gold prices, rising personal income, and the Indian wedding season from November to February are expected to have lifted gold demand as 2021 ended.

In the US, gold jewellery consumption grew by 12% in the September quarter 2021, and is expected to have remained strong over the rest of 2021, driven by the COVID-19 vaccine rollout, improved consumer sentiment and high household savings. In Europe, jewellery consumption is expected to have recovered, supported by stronger gifting demand during the festive season.

The risk to China's jewellery consumption is the debt issues in China's property sector, with Evergrande (China's second largest real estate developer) struggling to pay its debt of US$300 billion. The impact on consumer confidence could hurt jewellery demand.

Gold consumption expected to rise in 2022 and 2023

World gold consumption is forecast to grow at an average annual rate of 8.1% in 2022 and 2023, to 4,534 tonnes in 2023 (Figure 10.1). The growth is expected to be largely driven by jewellery consumption, which is forecast to rise by 9.6% a year in 2022 and 2023, to 2,263 tonnes in 2023.

Jewellery demand from China is expected to remain strong, supported by rising consumer sentiment and income. Chinese jewellery retailers are increasingly using private and social media channels to attract young Chinese consumers.

Demand from India is expected to recover in 2022 and 2023, as more people are vaccinated against COVID-19 and the economy recovers.

In the US, jewellery demand is expected to be lower than 2021, as consumer discretionary spending is expected to move towards leisure activities as COVID-19 restrictions and economic activity return to normality.

Gold retail investment is expected to help global gold consumption, with demand for gold bars and coins forecast to rise at an average annual rate of 1.0% to reach 1,231 tonnes by 2023. This is supported by a forecast pull-back in gold prices (see *Section 10.4 prices*).

The official sector is expected to add to gold demand in 2022 and 2023, as bond prices fall. As a result, central bank gold buying is forecast to rise by an average 14% a year over the outlook period, reaching 620 tonnes in 2023.

In October 2021, the National Bank of Poland (Poland's central bank) announced its plan to purchase 100 tonnes of gold in 2022. The central bank has said this planned addition aims to increase Poland's financial security by boosting the country's gold reserve to 330 tonnes putting Poland ahead of other major gold holders such as the UK, Saudi Arabia and Austria.

10.3 Production

World gold supply decreased in the September quarter 2021

World gold supply decreased by 3.2% year-on-year to 1,239 tonnes in the September quarter 2021. Driving the decline was a 22% year-on-year fall in gold scrap supply. Lower US dollar gold prices, improved economic activity and employment opportunities reduced the sale of gold from consumers to jewellery retailers in many parts of the world.

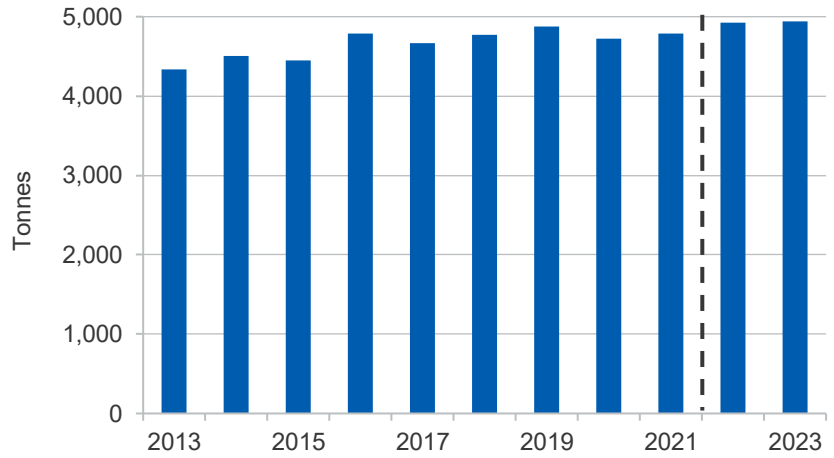
Offsetting the decline in gold scrap supply was an estimated 4.4% year-on-year rise in world gold mine production to 959 tonnes, as the COVID-19 containment measures impacted less on production.

Gold mine production in Canada rose by 23% year-on-year in the September quarter 2021, propelled by the ramp-up of production from new mines and the return to full production at the Musselwhite gold mine (following a fire incident in the March quarter 2019).

Over this period, gold mine production in Peru and South Africa rose by 25% and 18% year-on-year, respectively, driven by the easing of COVID-19 containment measures and improved ore grades.

China produced 84 tonnes of gold in the September quarter 2021. Stricter environmental regulation and safety checks led to a 10% year-on-year decline in China's gold mine production in the first three quarters of 2021, to 237 tonnes. Production at Shandong Gold Mining's gold mines in Shandong province fell by 45% year-on-year in the first nine months of 2021, impacted by safety inspection activities.

Figure 10.2: World gold supply



Source: World Gold Council (2021) Gold Demand Trends; Department of Industry, Science, Energy and Resources (2021)

Production in Australia decreased by 0.9% year-on-year to 80 tonnes in the September quarter 2021 (see *Section 10.5 Australia's exports and production*).

World gold supply estimated to rise in 2021

In 2021, world gold supply is estimated to have increased by 1.4% to 4,788 tonnes, driven by higher gold mine production in Canada and Latin America (Figure 10.2).

Production in Canada and the US in 2021 is estimated to rise by 12% and 17% to 224 and 212 tonnes, respectively, as production recovers from the disruption of the COVID-19 pandemic.

Canada's newest gold mine, Pure Gold, located in Ontario, started commercial operation on 1 August 2021. The mine is expected to add 3.1 tonnes of gold a year to Canadian gold output. Hudbay Minerals' New Britannia gold mine produced first gold on 11 August 2021, and is expected to add 5.6 tonnes a year to Canadian gold output.

Gold mine production in Latin America is recovered in 2021, following heavy losses in 2020. Production is estimated to increase in Mexico (by 15% in 2021 to 121 tonnes), Peru (up 14% to 100 tonnes) and Brazil (up 3.6% to 90 tonnes).

Chinese gold mine output is estimated to have fallen by 11% in 2021, to 335 tonnes, as power shortages and stricter environmental and safety regulations are expected to lead to production cuts and mine closures.

Gold recycling activity was subdued in 2021, as improved economic activity and increased personal income reduced the need to sell gold from consumers to jewellery retailers. As a result, world gold recycling supply is estimated to have fallen by 10% to 1,166 tonnes in 2021.

World gold supply expected to rise further in 2022 and 2023

Propelled by higher gold mine production, world gold supply is forecast to rise at an average annual rate of 1.6% in 2022 and 2023, reaching 4,944 tonnes by the end of the outlook period (Figure 10.2).

World gold mine production is forecast to increase by 3.0% (to 3,756 tonnes) in 2022 and by 2.0% (to 3,831 tonnes) in 2023, driven by increased production in Australia, Canada, Chile and the US.

In Australia, a solid pipeline of projects is expected to bring the country's gold mine production to 395 tonnes in 2023.

In Canada, gold mine production is forecast to rise to 258 tonnes in 2023. Sabina Gold and Silver's Back River gold mine in Nunavut province is expected to start operation in 2023, adding 4.7 tonnes of gold a year to Canadian gold output.

In Chile, Gold Fields' 8.8 tonnes a year Salares Norte gold project in the Atacama region is expected to come online in 2023.

In the US, Equinox is advancing an expansion at its Castle Mountain gold mine in California from 1.2 tonnes in 2021 to 6.2 tonnes a year in 2023.

In 2022 and 2023, lower gold prices and improving economic situations of many households are likely to discourage the sale of gold jewellery. Gold scrap supply is forecast to fall by 2.0% in 2022 (to 1,143 tonnes) and 7.0% in 2023 (to 1,063 tonnes).

10.4 Prices

Gold prices expected to finish the year on a positive note

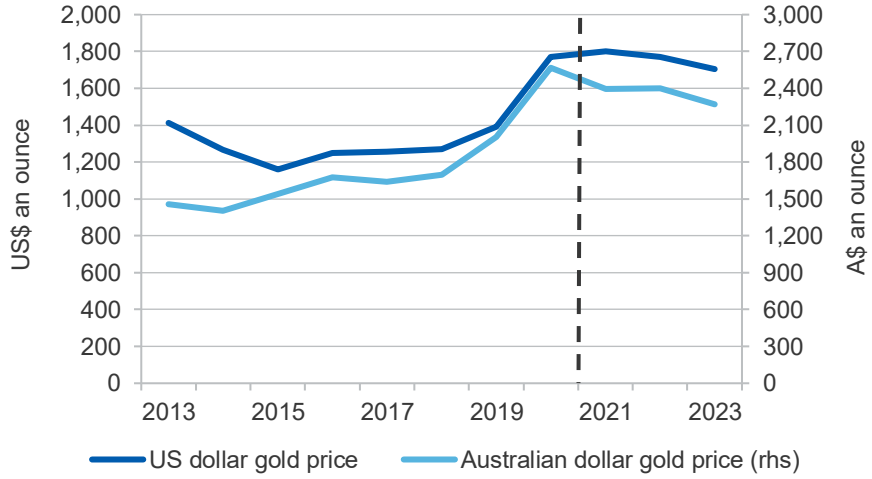
The gold price is estimated to average US$1,800 an ounce in 2021 (Figure 10.4), up from US$1,770 an ounce in 2020. The gold price is finishing the year strongly, as investors seek inflation hedges. The inflation has surged in many countries, as strong demand combines with supply chain problems. In the US, the annual inflation rate reached a three-decade high of 6.2% in October 2021. In Germany, the annual inflation rate reached a 29-year high of 5.2% in November 2021.

On 3 November 2021, the US Federal Reserve decided to take an incremental step to ease monetary stimulus by reducing its asset purchases to US$15 billion a month, starting from mid-November 2021.

Figure 10.3: US dollar gold price and real US 10-Year Treasury yield

Source: Bloomberg (2021)

Figure 10.4: US and Australian dollar gold prices



Source: LBMA (2021); Department of Industry, Science, Energy and Resources (2021)

Gold prices expected to fall in 2022 and 2023

Gold prices are forecast to fall by an average 2.7% a year, to US$1,700 an ounce in 2023, as the global economic recovery sees a higher interest rate environment (Figure 10.4). The US Federal Reserve's stance may help raise real bond yields, a major factor driving institutional investment demand for gold. With (real) interest rates increasing, the opportunity cost of holding gold is high, lowering its attractiveness as an investment asset.

There are several risks to the gold price assessment, including the rising cases of the new COVID-19 variant (namely Omicron) in many parts of the world. The World Health Organisation has declared the Omicron variant as a COVID-19 "variant of concern".

Another risk to the price assessment is a potential correction in global stock markets. A correction in the US' major stock markets may lift the demand for gold as a safe haven asset.

10.5 Australia's exports and production

Export values decreased in the September quarter 2021

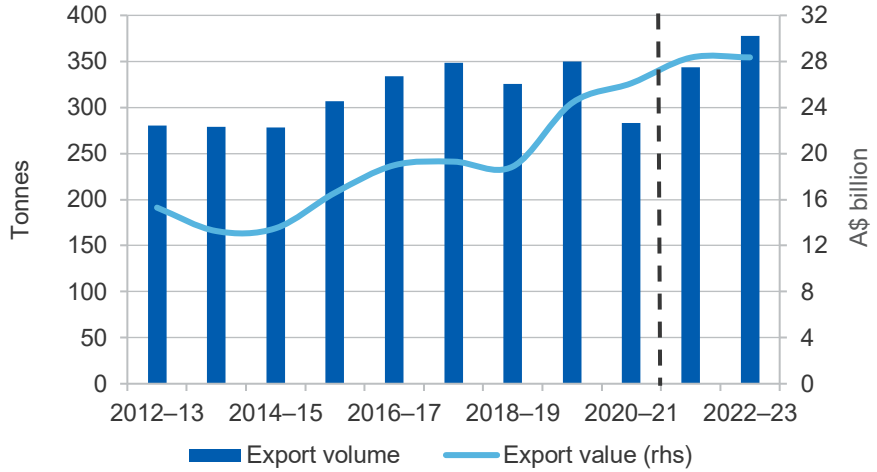
The value of Australia's gold exports decreased by 22% year-on-year to $5.4 billion in the September quarter 2021, due to a 95% year-on-year fall in exports to the UK, and a 94% year-on-year fall in exports to the US. Flows to the UK and US in the September quarter 2020 were driven by a strong inflow of global gold-backed ETFs.

Australia exported $2.2 billion of gold to China in the September quarter 2021. China did not import any gold from Australia in the September quarter 2020. Exports are volatile, often reflecting ETF flows.

Australian gold exports increase in 2021–22 and 2022–23

Australia's gold export earnings are forecast to increase at an average annual rate of 4.3% between 2021–22 and 2022–23, to $28.4 billion in 2022–23 (Figure 10.5). The growth in export earnings is expected to be driven by higher export volumes (to 377 tonnes in 2022–23).

Figure 10.5: Australia's gold exports



Notes: Export volume contains ash, waste and scrap gold, of which the gold content is unknown
Source: ABS (2021) International Trade, 5464.0; Department of Industry, Science, Energy and Resources (2021).

On 4 November 2021, the Papua New Guinea (PNG) Government has indicated that all gold mined in PNG will need to be refined in the country by 2025. The decision is expected to impact Newcrest's Lihir gold operations in the PNG, where the gold ore is shipped to the Perth Mint in WA for further refining. Newcrest is also in the process of negotiation with the PNG Government to build the Wafi-Golpu copper and gold mine in the PNG highlands, which is expected to be commissioned in 2026.

Australian gold mine production decreased in the September quarter 2021

Australia's gold mine production fell by 4.6% year-on-year to 77 tonnes in the September quarter 2021, impacted by labour shortages, plant maintenance, and lower ore grades.

Lower ore grades impacted output at a number of mines in the September quarter 2021. This included Kirkland Lake Gold's Fosterville gold mine in

Victoria (down by 17% year-on-year to 4.2 tonnes in the September quarter 2021), and AngloGold Ashanti's Sunrise Dam in WA (down by 22% year-on-year to 1.8 tonnes in the September quarter 2021).

Production at Newmont's Boddington operation in WA decreased by 6.1% to 5.1 tonnes in the September quarter 2021, due to lower throughput and ore grades. Output at Newcrest's Cadia mine in New South Wales declined by 45% year-on-year to nearly 3.4 tonnes in the September quarter 2021, due to planned maintenance, which included replacement and upgrade of the mill motor.

In the September quarter 2021, labour shortages affected gold output at several gold mines in WA. Production at Regis Resources' Duketon gold mine fell by 10% year-on-year, to 2.3 tonnes. Production at AngloGold Ashanti and Regis Resources' joint-venture Tropicana gold mine decreased by 10% year-on-year to nearly 3.0 tonnes.

Over the same period, a number of gold mines recorded a rise in gold output. Production at Newcrest's Telfer gold mine in WA rose by 17% year-on-year to 3.1 tonnes, propelled by higher gold recoveries.

Production at Northern Star Resources' Carosue Dam gold mine increased by 19% year-on-year to 2.0 tonnes, driven by higher ore grades.

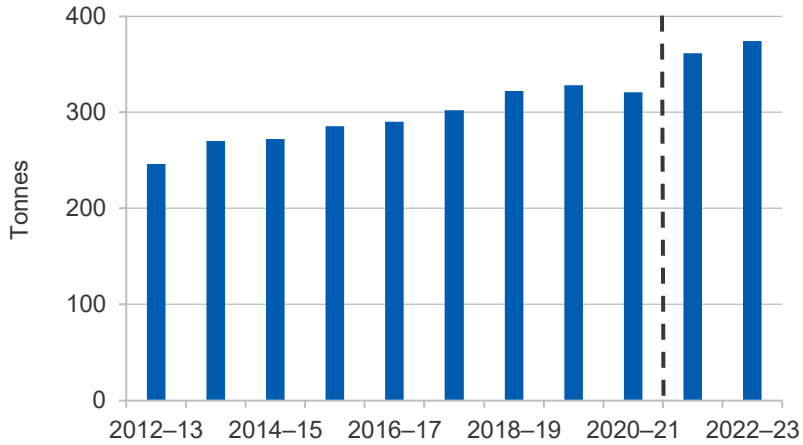
Production at Silver Lake Resources' Deflector gold mine in WA increased by 12% year-on-year to nearly 1.0 tonne, driven by higher ore grades.

Higher production in the short term

Australian gold mine production is forecast to rise at an average annual rate of 8.0% between 2020–21 and 2022–23. Production of 374 tonnes by 2022–23 will be propelled by both production from new mines and existing mine expansions (Figure 10.6).

Red 5's 6.2 tonnes a year King of the Hills gold project in WA is on track to start production in mid-2022, with construction activities accelerating on multiple fronts. Ramelius Resources started mining at its Tampia mine in WA on 18 June 2021. It is expected that the mine will add 3.2 tonnes of gold to the Australian gold output from 2021–22 and onwards.

Figure 10.6: Australia's gold production



Source: Department of Industry, Science, Energy and Resources (2021)

Newcrest has proceeded with the $246 million West Dome Stage 5 Cutback project to extend the life of its Telfer mine in WA. The first ore from the cutback is expected in the first half of 2022.

Resources and Energy Group poured the first gold at its Granny Venn gold mine in WA in October 2021 after operations 23 years ago. It is expected to produce 0.3 tonne of gold a year.

Calidus' 4.3 tonnes of gold a year Warrawoona gold mine in WA is expected to commence production in the June quarter 2022.

Newmont Mining commissioned the autonomous haulage system for its Boddington gold mine in WA in October 2021. With a fully autonomous haulage fleet of 36 trucks, the mine's safety and productivity are expected to improve after 2021.

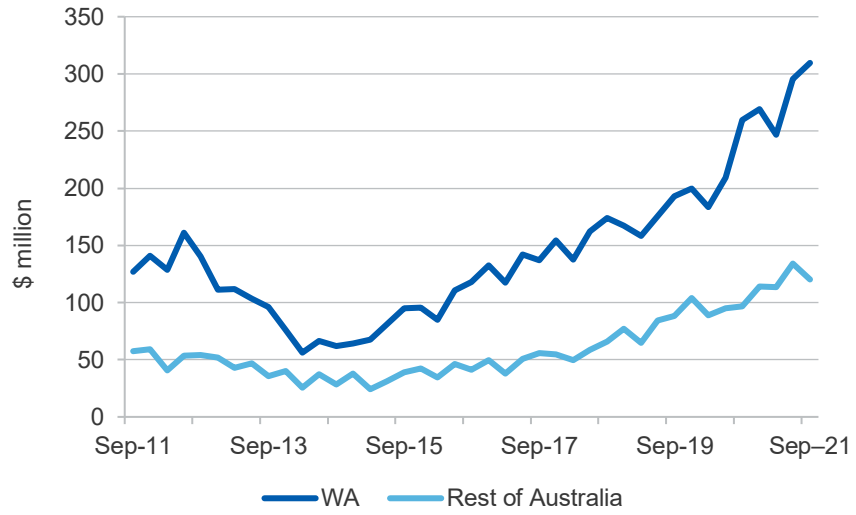
Gold Fields' St Ives gold operations in WA is the first Australian gold mine to use the new Sandvik battery electric vehicle underground loaders. As part of a production study over a two-year period, the electric battery technology used in each loader is expected to eliminate underground emissions, and reduce heat and noise compared to diesel loaders.

The risk to the outlook is the potential impacts of labour and skills shortages on Australian gold miners. Some parts of Australia are still implementing COVID-19 containment measures. In WA, unvaccinated workers have been banned from working in WA mines. It is mandatory for anyone visiting a mine site after 1 December 2021 to have had one jab, and two jabs will be required after 1 January 2022. These measures may cause a postponement of new projects and a production cut from existing gold mines.

Gold exploration expenditure rose in the September quarter 2021

Australia's gold exploration expenditure rose by 21% year-on-year to nearly $430 million in the September quarter 2021, incentivised by high US and Australian dollar gold prices. Western Australia remained the centre of gold exploration activity in Australia, accounting for 72% (or $310 million) of total gold exploration expenditure (Figure 10.7).

Figure 10.7: Australian gold exploration expenditure



Source: ABS (2021) Mineral and Petroleum Exploration, Australia, 8412.0

Revisions to the outlook

The estimate for the US dollar gold price has been revised up by 0.9% (or US$15 an ounce to about US$1,800 an ounce) in 2021, 4.1% (or US$70 an ounce to US$1,771 an ounce) in 2022, and 4.2% (or US$66 an ounce to about US$1,700 an ounce) in 2023, due to a larger than expected increase in gold prices in the December quarter 2021.

The forecast for Australian gold mine production in 2021–22 and 2022–23 has been revised down by 2.7% and 1.3%, to 362 and 374 tonnes, respectively, due to a larger than expected decline in output of some major gold mines in the September quarter 2021.

The forecast for Australian gold exports in 2021–22 has been revised down by $436 million to $28.3 billion, reflecting a larger than expected fall in export volumes in the September quarter 2021.

Export earnings in 2022–23 have been revised up by nearly $1.1 billion to $28.4 billion from the forecast in the September 2021 *Resources and Energy Quarterly*, reflecting an upward revision in the forecast gold prices.

Table 10.1: Gold outlook

						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021[s]**	**2022[f]**	**2023[f]**
Total demand	tonnes	3,732	3,880	4,212	4,534	4.0	8.6	7.6
Fabrication consumption[b]	tonnes	1,703	2,220	2,344	2,615	30.3	5.6	11.5
Mine production	tonnes	3,473	3,647	3,756	3,831	5.0	3.0	2.0
Price[c]								
Nominal	US$/oz	1,770	1,801	1,771	1,703	1.8	-1.7	-3.8
Real[d]	US$/oz	1,835	1,801	1,712	1,604	-1.8	-5.0	-6.3
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Mine production	tonnes	329	321	362	374	-2.2	12.6	3.4
Export volumes	tonnes	350	283	344	377	-19.0	21.5	9.7
Export value - Nominal	A$m	24,394	26,105	28,329	28,350	7.0	8.5	0.1
Export value - Real[e]	A$m	25,390	26,737	28,329	27,751	5.3	6.0	-2.0
Price								
Nominal	A$/oz	2,338	2,481	2,470	2,337	6.1	-0.4	-5.4
Real[e]	A$/oz	2,434	2,542	2,470	2,288	4.4	-2.8	-7.4

Notes: **b** includes jewellery consumption and industrial applications; **c** London Bullion Market Association; **d** In 2021 calendar year US dollars; **e** In 2021–22 financial year Australian dollars; **f** Forecast; **s** Estimate. Gold export volume contains ash, waste and scrap gold, of which the metal content is unknown.

Source: ABS (2021) International Trade, 5464.0; London Bullion Market Association (2021) gold price PM; World Gold Council (2021); Department of Industry, Science, Energy and Resources (2021).

Aluminium

13 Al 26.982

Major Australian bauxite deposits (Gt)

Key consumer markets for primary aluminium, 2020

60% China

7% United States

3% India

3% Germany

3% Vietnam

Aluminium

Bauxite is refined to **recover alumina** and smelted to make **aluminium**

2-3 tonnes of bauxite is required to produce one tonne of alumina

China is the world's largest producer & consumer of **primary aluminium**

Each electric vehicle **contains 0.25 tonne** of aluminium

Australia's aluminium

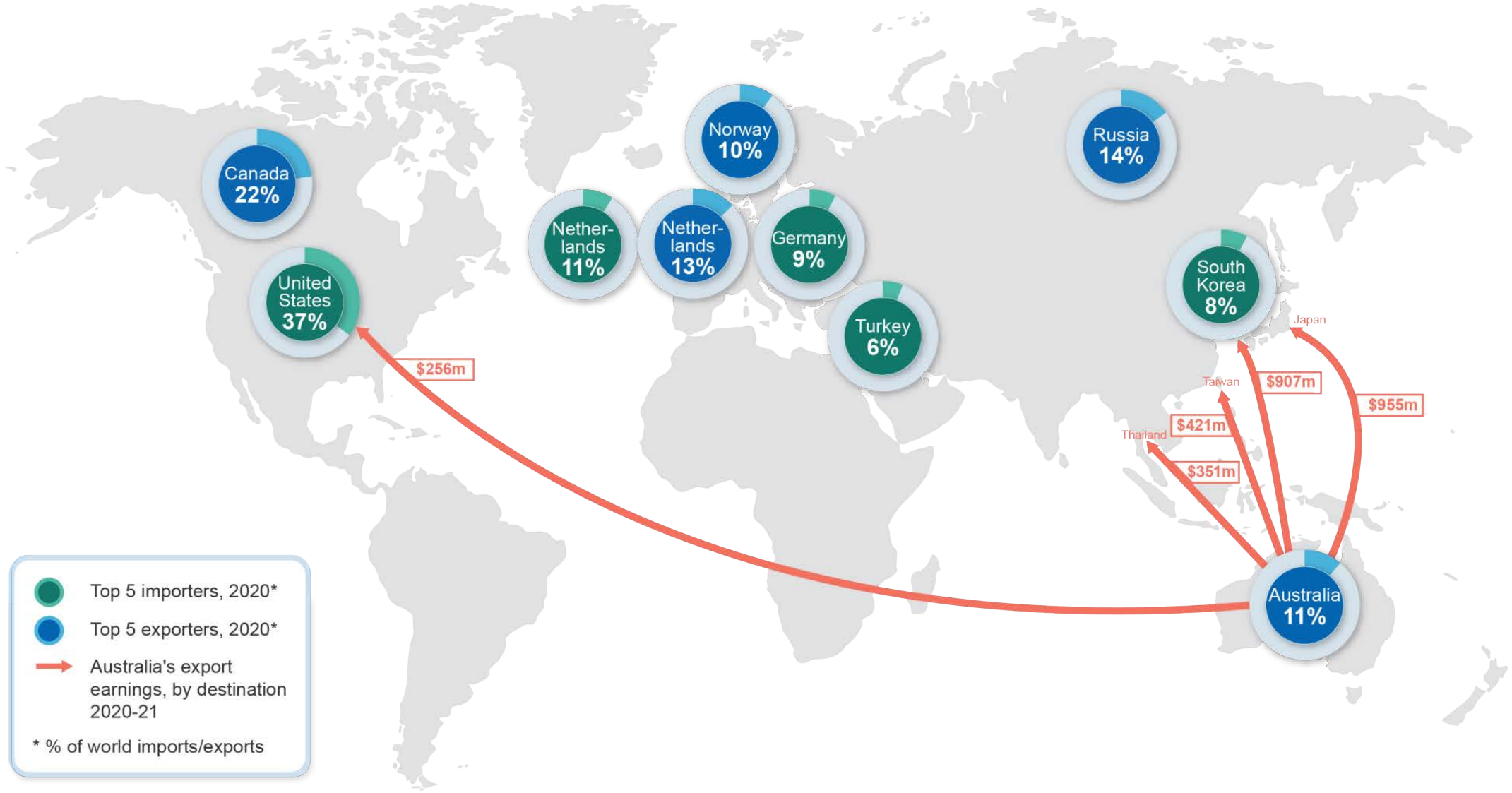
World's 1st **bauxite** producing nation

World's 1st **alumina** exporter in 2020

World's 2nd **alumina** producer in 2020

13 Al 26.982 Aluminium

Trade map | December 2021



11.1 Summary

- Energy shortages, emission curbs and political instability in Guinea have constrained primary aluminium production and recently pushed the London Metal Exchange (LME) aluminium spot price to a 13-year high. World demand is expected to remain strong, with the primary aluminium price forecast to rise to an average US$2,680 a tonne in 2023.
- A restart of idled capacity at the Portland Aluminium smelter in Victoria in the September quarter 2022 is expected to boost Australian primary aluminium output to above 1.6 million tonnes a year. Annual Australian alumina output is expected to be broadly steady over the outlook period, remaining at 21 million tonnes (see Australia section).
- The total value of Australian exports of aluminium, alumina and bauxite is forecast to increase by 31% in 2021–22 to nearly $16 billion, before falling to nearly $15 billion by the end of the outlook period.

11.2 Consumption

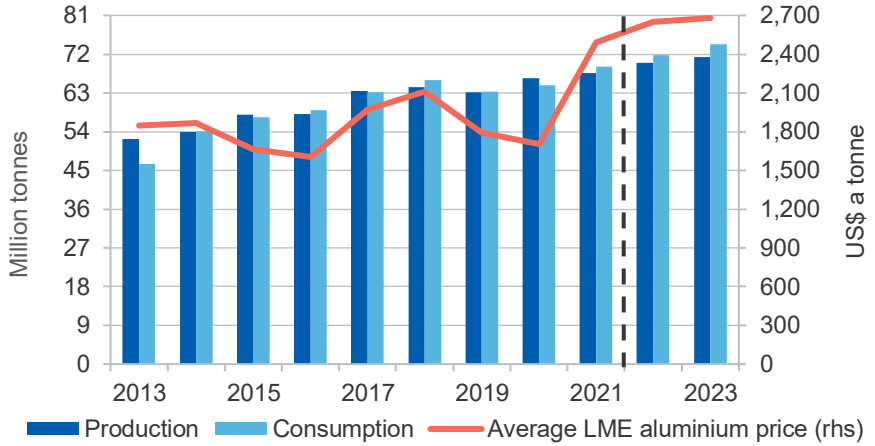
Strong aluminium, alumina and bauxite usage in the past year

World primary aluminium consumption grew by 3.5% year-on-year to nearly 17 million tonnes in the September quarter 2021, propelled by increased consumption in the US (up 12% year-on-year), Japan (up 45% year-on-year) and Germany (up 51% year-on-year). The growth in primary aluminium consumption partly reflects an increased aluminium use in new energy efficient car models.

Offsetting the rise in consumption from the US, Germany and Japan is a 3.8% year-on-year fall of primary consumption in China — the world's largest primary aluminium consuming country — in the September quarter 2021. High primary aluminium prices, power restrictions and stricter environmental regulation have softened aluminium demand in China.

Energy shortages and higher aluminium prices also affected primary aluminium demand in India: in the September quarter 2021, primary aluminium consumption fell by 7.8% year-on-year to 365,000 tonnes.

Figure 11.1: World aluminium production, consumption and prices



Source: World Bureau of Metal Statistics (2021); Department of Industry, Science, Energy and Resources (2021)

World primary aluminium consumption is estimated to increase by 6.6% to 69 million tonnes in 2021, propelled by a 7.0% rise in aluminium usage in China (Figure 11.1). China's primary aluminium imports grew by 14% year-on-year in the first three quarters, to around 2.3 million tonnes. The growth in imports is due to a power supply shortage that led to curbs on energy-intensive aluminium production in China. China's primary aluminium imports are expected to have risen further in the December quarter, as the demand for primary aluminium outpaces supply in China.

Global demand for the lightweight metal used in cars, food packaging and a range of other items is expected to exceed global production, as COVID-19 containment measures ease across many parts of the world. One risk to primary aluminium demand is an expected fall in global automotive production and sales due to supply chain issues. On 20 August 2021, Toyota announced a reduction in car production by 40% in September 2021, due to a shortage of microchips. According to IHS Markit, the global shortage of semiconductors is likely to have cut global auto production by over 7.0 million units in 2021. This supply disruption is expected to persist until the second-half of 2022.

The global automotive industry is also facing a critical shortage of magnesium — an essential raw material for the production of aluminium alloys used in gearboxes, steering columns, fuel tank covers and seat frames. Stockpiles are running low, and there is no substitute for magnesium in the production of aluminium sheets. In Europe, the supply of magnesium is expected to be exhausted by the end of November 2021. In Canada, some metal producers were told in October 2021 that magnesium supply had already dried up.

World alumina usage increased by 1.7% year-on-year to 33 million tonnes in the September quarter 2021, driven by 1.5% growth in aluminium production over the same period.

World alumina demand is expected to increase by 1.7% to nearly 132 million tonnes in 2021 (Figure 11.2). An expected 3.7% rise in global primary aluminium production in 2021 is likely to lift global alumina demand. China is expected to contribute strongly to the growth in global alumina demand, with an estimated 2.0 million tonnes of new primary aluminium capacity added in 2021.

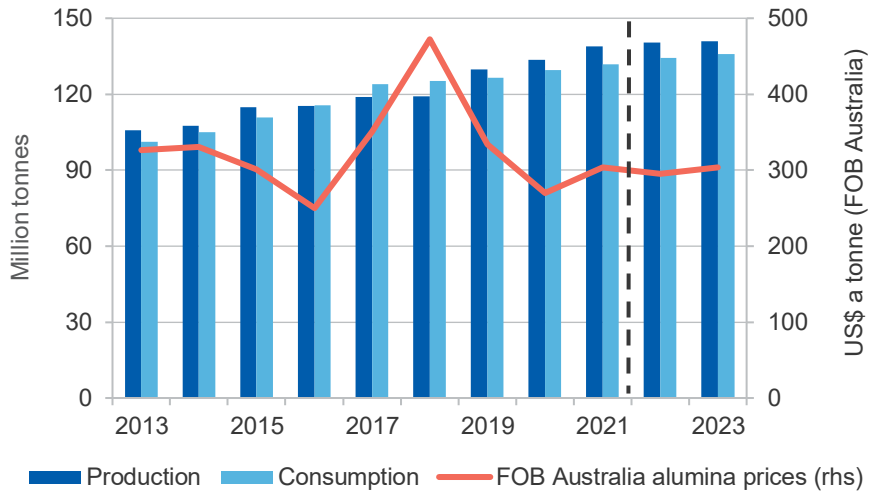
World bauxite usage increased by 6.4% year-on-year to 81 million tonnes in the September quarter 2021, propelled by increased global alumina production (up 1.4% year-on-year in the September quarter 2021) (see *Section 11.4 production*).

World bauxite consumption is estimated to grow by 5.0% to 323 million tonnes in 2021. The gains are expected to be driven by higher alumina output from existing refinery capacity in China and Brazil.

Global recovery to lift aluminium/alumina/bauxite demand in 2022/2023

World primary aluminium demand is forecast to rise at an average annual rate of 3.7% in 2022 and 2023, reaching 74 million tonnes by 2023(Figure 11.1). The global economic recovery is expected to support demand for cars, houses and electrical equipment, all of which utilise aluminium. An expected increase in the use of renewable energy equipment — such as wind and solar power generators — will also boost primary aluminium demand over the outlook period.

Figure 11.2: World alumina production, consumption and prices



Source: World Bureau of Metal Statistics (2021); Department of Industry, Science, Energy and Resources (2021)

China's primary aluminium consumption is expected to continue to grow over the next two years, reaching 45 million tonnes in 2023. The Chinese Government's ambitious initiatives for promoting electric vehicle production are expected to bolster the demand for aluminium.

On 6 November 2021, the US House of Representatives passed a US$1.5 trillion infrastructure package, which should provide further upside to primary aluminium demand during the outlook period and beyond.

World alumina consumption is forecast to rise at an average annual rate of 1.5% in 2022 and 2023, reaching 136 million tonnes in 2023 (Figure 11.2). The rise in alumina demand is expected to be driven by a 2.8% rise in primary aluminium production in 2022 and 2023.

World bauxite consumption is forecast to grow at an average annual rate of 3.6% in 2022 and 2023, reaching 346 million tonnes in 2023. This is expected to be driven by the ramp up of new alumina capacity in China and India.

11.4 Production

Aluminium/alumina/bauxite output rose in the September quarter 2021

Global primary aluminium production increased by 1.5% year-on-year to nearly 17 million tonnes in the September quarter 2021, propelled by higher output in China — the world's largest aluminium producer. China produced 9.7 million tonnes of primary aluminium over the September quarter 2021, up by 2.3% year-on-year, as primary aluminium producers responded to the highest primary aluminium price in thirteen years. Primary aluminium output at Aluminium Corporation of China — the world's third largest primary aluminium producing company — increased by 5.8% year-on-year to 2.9 million tonnes in the first three quarters of 2021.

The aluminium smelters in China's Henan province that suffered due to floods in July 2021 have yet to resume the idled capacities. It is unlikely that the idled capacities can be restored before the end of 2021. More restrictions on production may also be imposed over the coming winter, which would reduce primary aluminium output in China. Around 3.0 million tonnes of China's primary aluminium capacity have been cut since the start of 2021.

Offsetting this reduction, around 2.0 million tonnes of new primary aluminium capacity will be added to Chinese production in 2021.

Recent power shortages have prompted the Chinese authorities to take a new approach to coal supply to ensure enough energy supply is available to industrial provinces. The number of provinces with significant power shortages was reduced from 18 in mid-October 2021 to 2 in early November 2021. As a result, China's total primary aluminium production in 2021 is estimated to be 38 million tonnes (up 3.7% from 2020).

Energy shortages and higher energy costs are affecting the operations of aluminium smelters across the world. In India, the curtailment of coal supply to local aluminium smelters is likely to cause considerable impacts to the aluminium industry which employs over one million people. In Spain, the future of Alcoa's San Ciprián aluminium smelter is uncertain, as the company weighs up a possible production cut or business sale.

Primary aluminium output in Norway is expected to rise by 23% in 2021, to 1.6 million tonnes, driven by the production ramp up at Hydro's Husnes aluminium smelter.

Primary aluminium production in the United Arab Emirates is expected to increase by 2.0% in 2021, to 2.3 million tonnes, as Emirates Global Aluminium brought online 26 new reduction cells at potline 1 of its Al-Taweelah aluminium smelter in the first-half of 2021. These new reduction cells have added an extra 30,000 tonnes annual capacity. Another 66 new reduction cells have been operational since early November 2021, adding a further 48,000 tonnes of annual capacity.

In the US, primary aluminium production is estimated to decline by 11% in 2021, to 911,000 tonnes, due to supply chain bottlenecks.

Over the same period, primary aluminium production in Iran rose by 23% year-on-year to 125,000 tonnes, driven by the ramp up of production at the 1.0 million tonnes per year SALCO aluminium smelter. Primary aluminium production in Canada grew by 1.3% year-on-year, to 795,000 tonnes. The growth is driven by the ramp up of production at the Alouette aluminium smelter (600,000 tonnes a year).

On balance, world primary aluminium production is estimated to increase by 1.8% to nearly 68 million tonnes in 2021 (Figure 11.1), due to energy shortages and high energy prices.

World alumina supply increased by 1.7% year-on-year in the September quarter 2021, to 104 million tonnes, driven by a 1.3% year-on-year rise in China's alumina output. Chinese alumina refiners raised output to accommodate higher aluminium production. Alumina production at Aluminium Corporation of China increased by 13% year-on-year to over 12 million tonnes in the first three quarters of 2021.

Outside of China, around 2.0 million tonnes of alumina refinery capacity was idled in the September quarter 2021. In Brazil, structural damage to a ship unloader in July 2021 reduced the 1.2 million tonnes a year Alumar

alumina refinery's capacity by one third. Also in Brazil, a fire incident in late August 2021 reduced the 1.4 million tonnes a year Jamalco alumina refinery's capacity by 60%.

Production in Australia — the second largest alumina producer after China — fell by 3.3% year-on-year in the September quarter 2021, to 5.0 million tonnes.

World alumina supply is estimated to rise by 3.9% to nearly 139 million tonnes in 2021, driven by higher output in China and India. In China, Aluminium Corporation of China's 2.0 million tonnes per year Huasheng Alumina Refinery started producing in September 2020, and ramped up output in 2021.

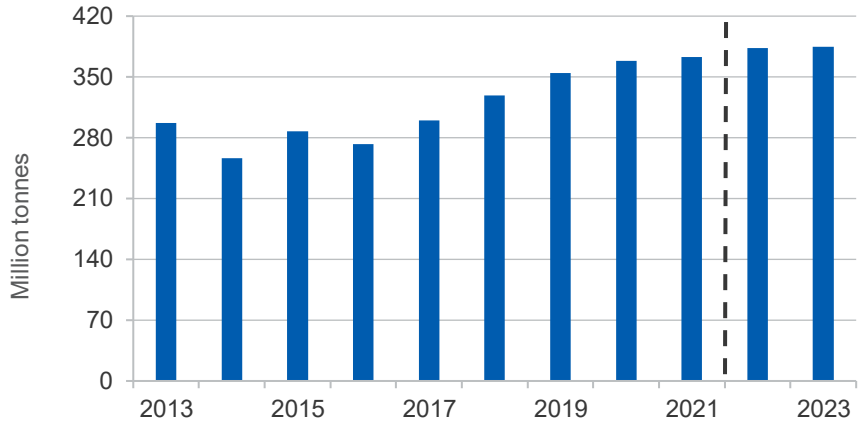
Risks to the forecasts include a continuation of energy curtailment policy from local authorities in China. Alumina production cuts have increased in line with primary aluminium. Guangxi province officials reportedly asked local alumina refineries to cut production by 50% in mid-August, which may increase to 70% cuts by the end of 2021. With an annual refining capacity of 10 million tonnes a year, this curtailment is likely to remove over 1.0 million tonnes of China's alumina output in the December quarter 2021.

World bauxite supply increased by 3.6% year-on-year to 92 million tonnes in the September quarter 2021, propelled by higher output in Guinea — the world's second largest bauxite producing country. Bauxite output in Guinea increased by 5.6% year-on-year as the ramp up of production continued. Chalco's Boffa bauxite mine has ramped up its production from 7.0 million tonnes in 2020 to an estimated 9.0 million tonnes in 2021.

Output in Australia — the world's largest bauxite producing country — fell by 2.2% year-on-year to nearly 26 million tonnes in the September quarter 2021 (see *Section 11.4 Australia's exports and production).*

Despite recording year-on-year growth in the September quarter 2021, Guinea's bauxite production fell by 9.4% quarter-on-quarter to under 20 million tonnes in the September quarter 2021. The results reflect political instability, which has the potential to persist.

Figure 11.3: World bauxite production



Source: Department of Industry, Science, Energy and Resources (2021)

In 2021, world bauxite supply is estimated to rise by 1.4% to 374 million tonnes, driven by higher production in Australia (up 0.6% to 104 million tonnes) and Brazil (up 8.3% to 32 million tonnes) (Figure 11.3).

Aluminium, alumina and bauxite output set to rise over the outlook period

World primary aluminium output is forecast to rise at an average annual rate of 2.7% in 2022 and 2023, to hit 71 million tonnes by 2023 (Figure 11.1). The gains are likely to be driven by additions to Chinese capacity.

China's primary aluminium output is forecast to reach 41 million tonnes by 2023. This is edging closer to the capacity cap of 45 million tonnes of primary aluminium per year — a policy introduced by the Chinese Government in 2017, in response to environmental and oversupply concerns. The Chinese Government's Five Year Plan (2021–25), calls for China's production and capacity of both primary aluminium and alumina to peak by 2025. The closer China edges to its primary aluminium capacity cap, the greater the opportunity for other primary aluminium producing nations — such as Russia, Canada and Saudi Arabia — to fill the output gap. Central and provincial authorities in China are expected to continue implementing strict environmental regulations — restricting energy consumption and emissions — from 2022 and onwards.

Notwithstanding the power crisis in China, an increasing number of Chinese aluminium smelters have considered investment overseas where power and labour costs are more stable and lower. Huafeng Group and Qingshan Industry have invested in the Huaqing aluminium project in Indonesia, which is expected to start operation in 2022.

On 2 November 2021, the Central Committee of the Communist Party of China and the State Council released the opinions on deepening pollution prevention and control. The opinions outline that a clean and low-carbon energy economy is to be strongly promoted, with outdated and excess production capacity to be eliminated. No extra aluminium and alumina capacity will be approved in key regions.

World alumina supply is forecast to rise at an average annual rate of 0.7% in 2022 and 2023, reaching 140 million tonnes in 2023 (Figure 11.2). This growth will be driven by India and other small alumina refining nations.

In India, Vedanta's 2.0 million tonnes per year Lanjigarh expansion project is expected to be completed in early 2023. Once completed, it will bring the refinery capacity to 5.0 million tonnes a year. Hindalco's 1.5 million tonnes a year Utkal Alumina Refinery expansion project is expected to complete in 2022. The refinery's capacity is expected to increase from 1.5 to 2.0 million tonnes a year. In Indonesia, China Hongqiao and joint-venture partners' 2.0 million tonnes a year Well Harvest alumina refinery expansion project is expected to come online in 2022.

World bauxite output is forecast to grow at an average annual rate of 1.6% in 2022 and 2023, reaching 386 million tonnes by 2023 (Figure 11.3). The gains are expected to be driven by newly added capacity in Guinea, where production is rising rapidly. Guinea's bauxite output is forecast to grow at an average 4.0% a year in 2022 and 2023. The Compagnie des Bauxites de Guinée mine in Guinea, which expanded from 13 to 18 million tonnes a year in 2019, is due to expand further to 28 million tonnes by 2022. Emirates Global Aluminium is ramping up output at its 12 million tonnes a year bauxite mine in Guinea.

11.3 Prices

A strong year for primary aluminium price

The LME spot price for primary aluminium is expected to start the new year on a positive note, as energy consumption restrictions and strict environmental regulation in China continue to limit supply. On the consumption side, global demand for everything from beer cans to packaging has rebounded from the lows of the COVID-19 pandemic in 2020. On the cost side, political instability in Guinea — the world's second largest bauxite producer and the world's largest bauxite exporter — is pushing up the cost of bauxite.

Global energy supply constraints and rising input costs have led to a decline in global primary aluminium inventories. LME stocks reached a 4-year high in April 2021, at 1.8 million tonnes. SHFE stocks rose in the March quarter 2021, but fell from April to September. LME off- warrant stocks rose in the year after the data was first released in early 2020, but have fallen since March 2021 (Figure 11.4). The LME aluminium spot price reached a 13-year high of US$3,180 a tonne on 18 October 2021.

In an attempt to boost primary aluminium supply and limit the rise of aluminium prices, the Chinese Government held three auctions in July and September 2021, releasing 210,000 tonnes from state reserves. It is estimated that about 900,000 tonnes of primary aluminium are still held. The sale of state primary aluminium reserves seems to have had a very minimal impact on the market, accounting for only 0.3% of China's primary aluminium demand. At the end of October 2021, the Chinese Government also stepped up policies to boost coal output to lower energy shortages and thus prices.

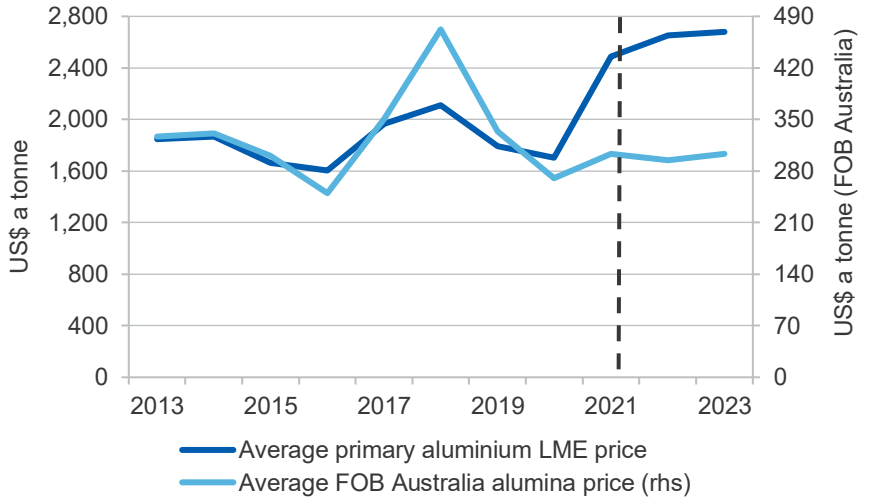
These initiatives have lowered the LME primary aluminium price by almost 20% below its 13-year high of US$3,180 a tonne on 18 October 2021.

It is expected that the tax on primary aluminium exports will not be extended after 31 December 2021, as it increases export prices and puts Rusal — the world's second largest aluminium supplier — in a less competitive position globally.

Figure 11.4: Exchange aluminium stocks

Source: London Metal Exchange (2021); World Bureau of Metals Statistics (2021)

Figure 11.5: World primary aluminium and alumina prices



Source: LME (2021) spot prices; Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021)

The LME primary aluminium spot price is likely to average around US$2,490 a tonne in 2021, up 46% from 2020 (Figure 11.5). In line with the rise in primary aluminium price, the free on board (FOB) Australian alumina price is expected to finish the year on a positive note, driven by supply disruptions in several parts of the world (see *Section 11.4 production*). Alumina demand is expected to remain strong, as world primary aluminium production is estimated to increase by 1.8% in 2021 to nearly 68 million tonnes. As a result, the FOB Australian alumina price in 2021 is up by 20% to average US$325 a tonne.

Aluminium and alumina prices expected to rise in 2022 and 2023

The LME aluminium spot price is forecast to increase by 6.4% to average US$2,650 a tonne in 2022, and to rise by a further 1.1% to average US$2,680 a tonne in 2023 (Figure 11.5). Increasing input costs and rising primary aluminium consumption in China and in the global transport (aviation and car manufacturing) industry generally are expected to be significant drivers of increased aluminium prices.

One risk to the price assessment is the Chinese Government's discounted electricity prices for Chinese aluminium smelters, which are expected to come to an end on 1 January 2022. The Xinjiang Uygur Autonomous Region — China's second largest primary aluminium producing region — released a draft notice on 15 October 2021 that prevents primary aluminium smelters in the region from receiving preferential electricity prices from 1 January 2022. In October 2021, the Inner Mongolia Autonomous Region, Qinghai and Gansu provinces also announced plans to phase out preferential electricity prices to primary aluminium smelters. On 19 September 2021, Yunnan province cancelled its preferential electricity scheme with aluminium smelters in the province.

The FOB Australian alumina price is forecast to rise at an average annual rate of 4.6% in 2022 and 2023, to US$355 a tonne by 2023 (Figure 11.5). A forecast 2.7% average annual rise in world aluminium production in 2022 and 2023 is expected to provide support to alumina prices.

11.4 Australia's exports and production

Higher aluminium prices drove exports in the September quarter 2021

Australia's aluminium, alumina and bauxite exports increased by 25% year-on-year to $3.6 billion in the September quarter 2021, driven by higher primary aluminium prices. A 55% year-on-year rise in the LME aluminium price in the September quarter 2021 and stronger demand for primary aluminium boosted Australian primary aluminium export volumes and values by 24% (to 385,000 tonnes) and 81% (to nearly $1.4 billion) year-on-year in the September quarter 2021.

Primary aluminium exports to Japan increased by 242% year-on-year to $403 million in the September quarter 2021, as more energy efficient car models require higher aluminium content. In a similar trend, Australian primary aluminium exports to Thailand and Taiwan rose by 421% and 134% year-on-year in the September quarter 2021.

Australian alumina export volumes and values rose by 1.2% (to 4.6 million tonnes) and 9.2% (to $1.8 billion) year-on-year in the September quarter 2021.

Australian bauxite exports increased by 18% quarter-on-quarter to $373 million in the September quarter, but were 10% lower year-on-year. Australia's share of China's total bauxite imports rose by 2.5% quarter-on-quarter to nearly 33%, as Australian product filled in for declining output in Guinea (see the September 2021 edition of the *Resources and Energy Quarterly*).

Exports to rise over the outlook period

An expected gain in aluminium and alumina prices over the outlook period is likely to provide additional earnings for Australian aluminium smelters. Australia's aluminium, alumina and bauxite exports are forecast to increase by 31% to nearly $16 billion in 2021–22, before falling by 5.8% to nearly $15 billion in 2022–23, as primary aluminium prices retreat from a 13-year high.

An agreement reached at the G20 Summit in Italy in October 2021 between the European Union (EU) and the US has paused a trade dispute on steel and aluminium tariffs imposed in 2018. While maintaining tariffs of 25% on steel and 10% on aluminium, the agreement allows limited quantities of European steel and aluminium products to be imported tariff free by the US for two years. The US and Japan are also seeking to make a deal on the same issue with the EU.

The agreement is unlikely to have any direct impacts on Australian exports of primary aluminium to the US, as no Australian primary aluminium was exported to the US in 2020–21. However, it is likely to have indirect impacts on Australian bauxite exports to China. China is Australia's largest bauxite export market with exports of $1.3 billion in 2020–21.

The Indonesian Government has indicated that its bauxite export ban — planned to commence in 2023 — is likely to come forward to 2022. The move is likely to provide Australian bauxite exporters with greater opportunity to fill the gap in the Chinese bauxite market, with Indonesia being China's third largest bauxite import source.

Lower aluminium, alumina and bauxite output in the September quarter

Australia's aluminium output decreased by 2.8% year-on-year to 390,000 tonnes in the September quarter 2021, due to a 2.3% year-on-year decline (to 125,000 tonnes) at Rio Tinto's Boyne Island aluminium smelter in Queensland, and a 11% fall (to 66,000 tonnes) at Alcoa's Portland Aluminium smelter in Victoria.

Australia's alumina output decreased by 3.3% year-on-year to just under 5.0 million tonnes in the September quarter 2021. The fall is due to a 3.3% decline at Rio Tinto's joint-venture Queensland Alumina Limited in Queensland.

Australia's bauxite production decreased by 2.2% year-on-year to just under 26 million tonnes in the September quarter 2021, due to a 2.5% year-on-year fall at Rio Tinto's Amrun bauxite operation in Queensland.

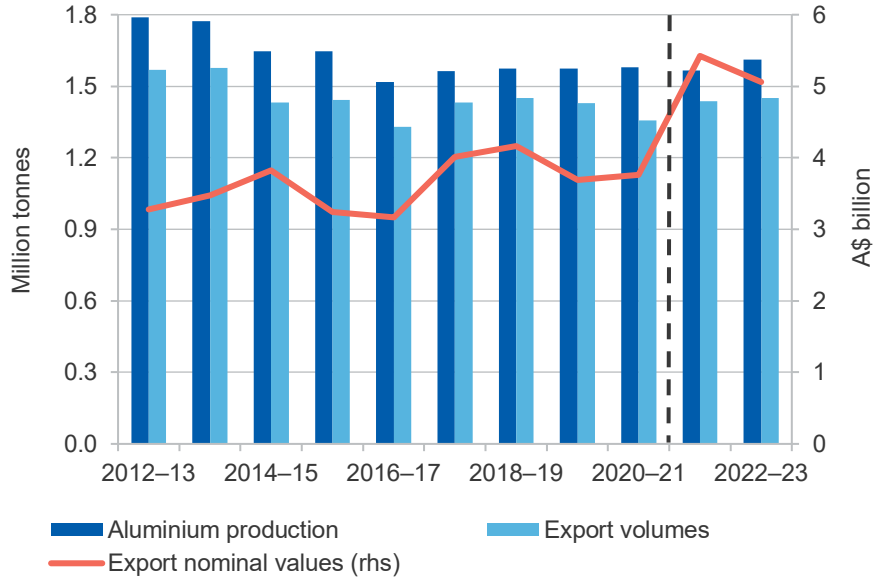
Higher aluminium/bauxite, and flat alumina output over the outlook period

On 7 November 2021, Alcoa Corporation announced a restart of 35,000 tonnes a year idled capacity at its Portland Aluminium smelter in

Victoria. The reactivated capacity is expected to come online in the September quarter 2022, and will bring the smelter's capacity up to 186,000 tonnes a year. The energy to operate the idled capacity is expected to be supplied under a new four-year agreement with the AGL. It will supplement the earlier announced five-year energy agreements with AGL, Alinta Energy and Origin Energy that commenced on 1 August 2021.

As a result, Australia's aluminium output is forecast to be above 1.6 million tonnes a year from 2022–23 and beyond (Figure 11.6).

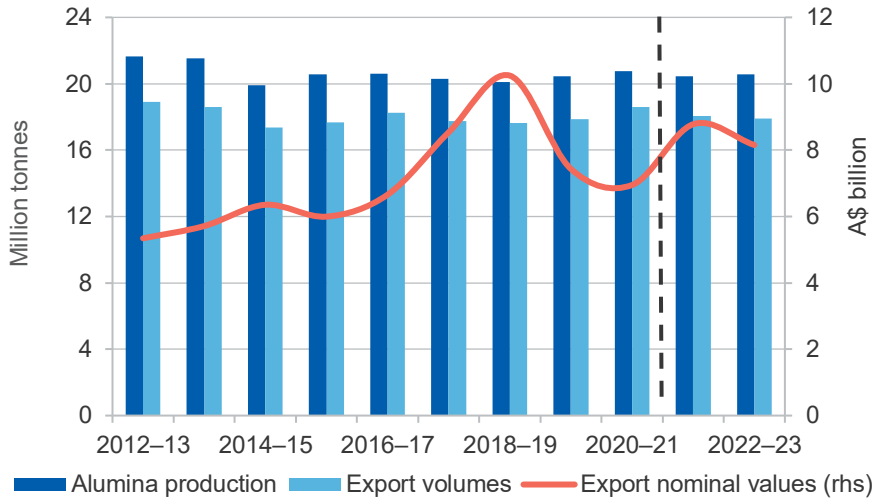
Figure 11.6: Australia's aluminium exports and production



Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

No expansions or major disruptions are expected at existing alumina operations in Australia over the outlook period. Australia's alumina output is expected to remain at about 21 million tonnes a year over the next two years (Figure 11.7).

Figure 11.7: Australia's alumina exports and production



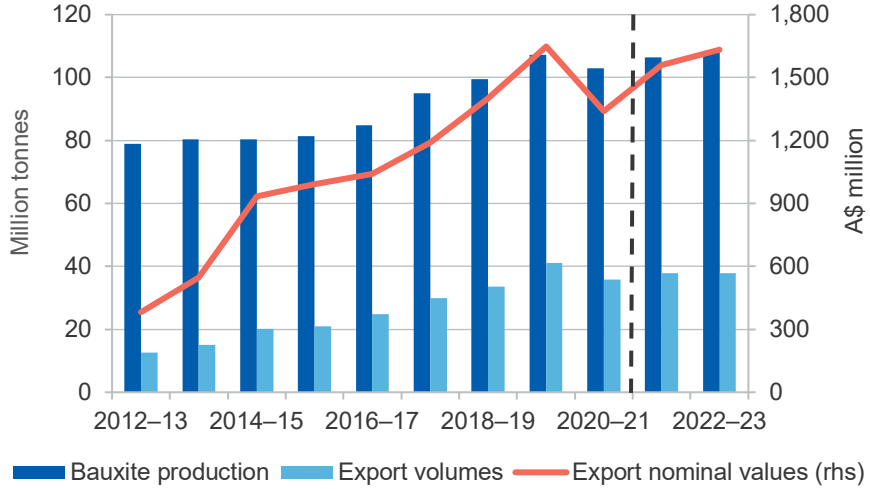
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Australia's bauxite output is forecast to rise at an average annual rate of 2.5% in 2021–22 and 2022–23, reaching 108 million tonnes in 2022–23 (Figure 11.8). Metro Mining's Bauxite Hills mine in Queensland is expected to reach full production capacity of 6.0 million tonnes a year by the December quarter 2021.

In October 2021, Rio Tinto announced the company will spend around $10 billion over the next 9 years to cut its carbon emissions. Part of the announced spending is for shifting its Australian aluminium smelters, alumina refineries and bauxite operations onto a largely renewable power source by 2030. The company plans to invest in wind and solar, including up to 5GW for its Boyne Island aluminium smelter in Queensland and Tomago aluminium smelter in NSW.

Queensland Alumina Refinery has ordered five medium-voltage variable speed drives from Siemens. These orders will bring in a cutting edge technology to help the refinery reduce energy usage and emissions.

Figure 11.8: Australia's bauxite exports and production



Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Revisions to the outlook

Forecasts for Australia's aluminium, alumina and bauxite export earnings have been revised up from the September 2021 *Resources and Energy Quarterly* — by $2.3 billion to nearly $16 billion in 2021–22, and by $1.3 billion to nearly $15 billion in 2022–23.

The revision reflects a larger-than-expected rise in aluminium and alumina prices, and export earnings in the September quarter 2021.

Table 11.1: Aluminium, alumina and bauxite outlook

						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021[s]**	**2022[f]**	**2023[f]**
Primary aluminium								
Production	kt	66,367	67,547	70,027	71,316	1.8	3.7	1.8
Consumption	kt	64,785	69,084	71,774	74,338	6.6	3.9	3.6
Prices aluminium[c]								
- nominal	US$/t	1,702	2,490	2,650	2,680	46.4	6.4	1.1
- real[d]	US$/t	1,764	2,490	2,561	2,523	41.2	2.8	-1.5
Prices alumina spot								
- nominal	US$/t	270	325	345	355	20.2	6.2	3.0
- real[d]	US$/t	280	325	333	335	15.9	2.7	0.3
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Production								
Primary aluminium	kt	1,574	1,579	1,566	1,613	0.3	-0.9	3.0
Alumina	kt	20,451	20,772	20,459	20,561	1.6	-1.5	0.5
Bauxite	Mt	107.2	103.0	106.4	108.1	-4.0	3.3	1.6
Consumption								
Primary aluminium	kt	199	284	179	209	42.6	-36.8	16.7
Exports								
Primary aluminium	kt	1,430	1,357	1,438	1,452	-5.1	5.9	1.0
- nominal value	A$m	3,692	3,763	5,424	5,062	1.9	44.1	-6.7
- real value[e]	A$m	3,843	3,854	5,424	4,955	0.3	40.7	-8.6
Alumina	kt	17,876	18,600	18,065	17,888	4.0	-2.9	-1.0
- nominal value	A$m	7,431	6,948	8,779	8,153	-6.5	26.3	-7.1
- real value[e]	A$m	7,735	7,117	8,779	7,981	-8.0	23.4	-9.1
Bauxite	kt	41,026	35,782	37,839	37,829	-12.8	5.7	0.0
- nominal value	A$m	1,648	1,339	1,560	1,634	-18.7	16.5	4.8
- real value[e]	A$m	1,715	1,372	1,560	1,599	-20.0	13.7	2.5
Total value								
- nominal value	A$m	12,771	12,050	15,763	14,849	-5.6	30.8	-5.8
- real value[e]	A$m	13,293	12,342	15,763	14,536	-7.2	27.7	-7.8

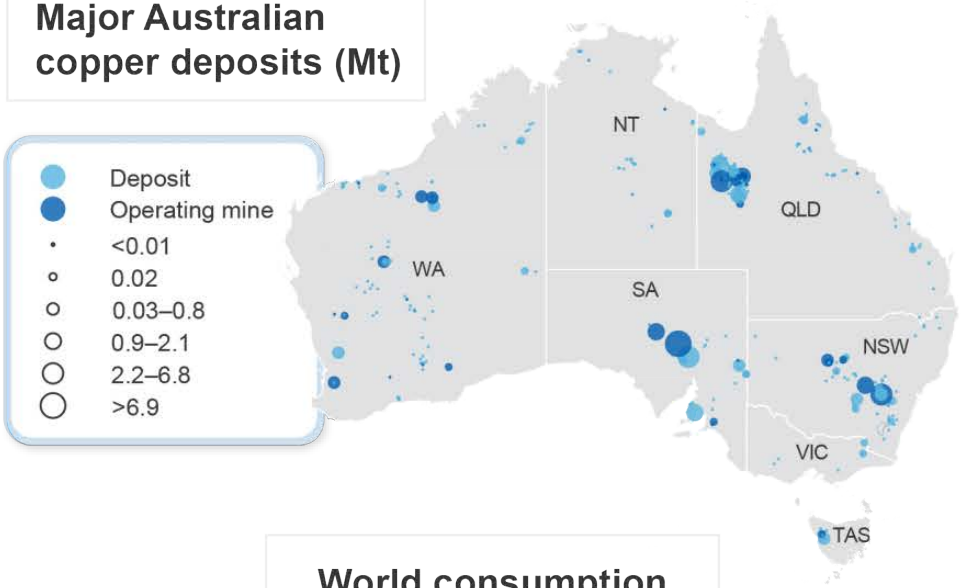
Notes: **c** LME cash prices for primary aluminium; **d** In 2021 calendar year US dollars; **e** In 2021–22 financial year Australian dollars; **f** Forecast; **s** Estimate

Source: ABS (2021) International Trade in Goods and Services, 5464.0; AME Group (2021); LME (2021); Department of Industry, Science, Energy and Resources (2021); International Aluminium Institute (2021); World Bureau of Metal Statistics (2021).

Copper

29 Cu 63.546

Major Australian copper deposits (Mt)



Copper facts

- The average home contains **180 kg of copper**
- 80% of copper ever produced **is still in use today**
- An electric car contains about **5x more copper** than an equivalent ICE car
- China consumes half of the **world's copper**

World consumption

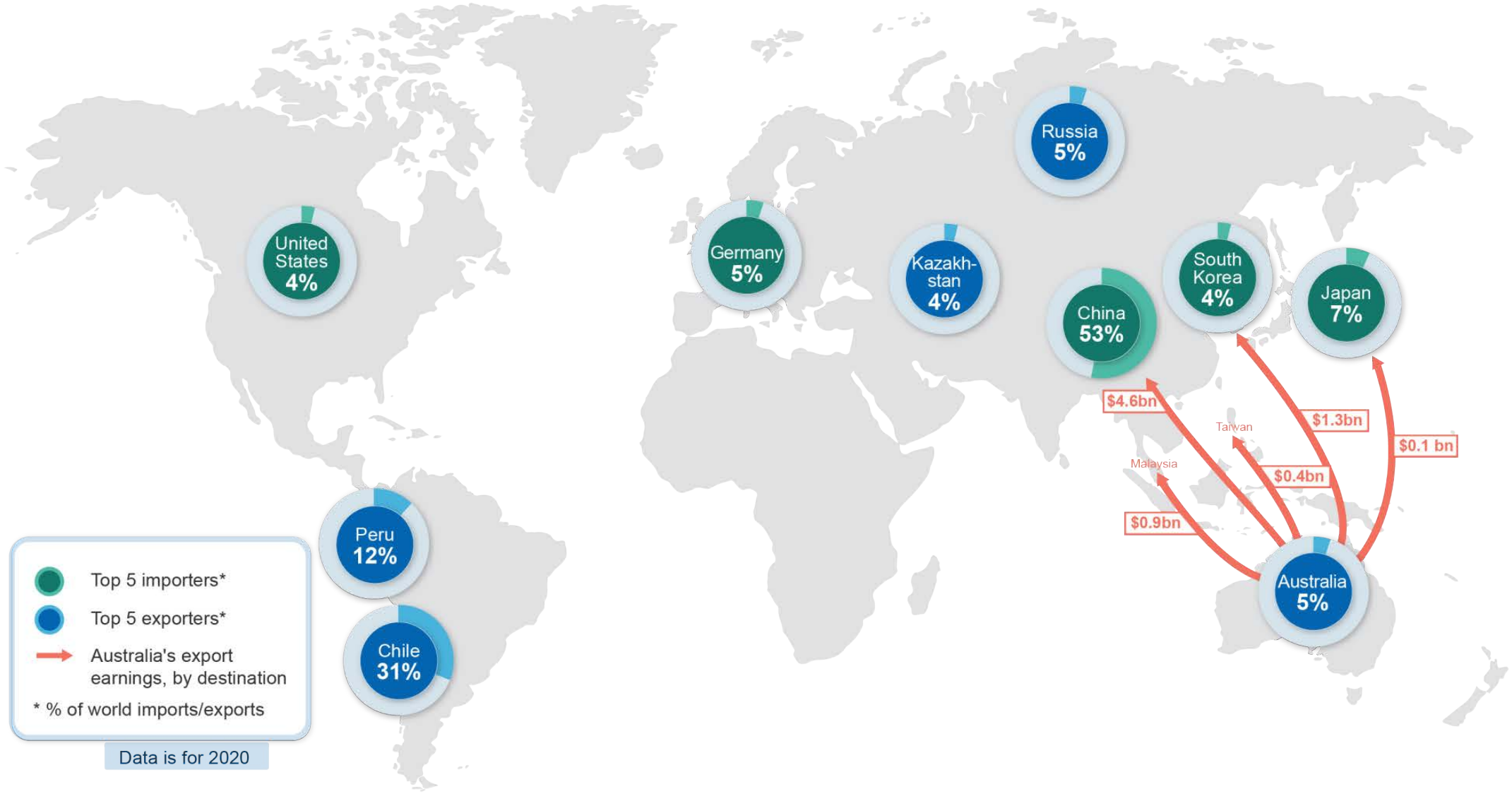
- **31%** Equipment
- **30%** Building Construction
- **15%** Infrastructure
- **12%** Transport
- **12%** Industrial

Australia's copper

- **Ranked no 2** for **copper resources**
- **6th largest mined copper producer** in the world
- **Copper exports** worth more than **$10 billion** in 2020

29 Cu 63.546 Copper

Trade map | December 2021



12.1 Summary

- Copper prices have surged in 2021, averaging US$9,200 a tonne over the year. High prices will be supported in 2022 through the continued economic recovery and the expanding use of copper in low-emissions technology. Prices are forecast to ease slightly to US$8,500 a tonne by 2023 as new mine supply comes online.
- Australia's copper export volumes are expected to rise slightly over the outlook period, from 898,000 tonnes in 2020–21, to around 934,000 tonnes in 2022–23 (in metal content terms) (see *Australia section*).
- Australia's copper export earnings are expected to increase — first from sustained price gains into 2022, then from increased export volumes in 2023. Export earnings are forecast to rise from $11.4 billion in 2020–21 to $14.7 billion in 2022–23.

12.2 World consumption

Consumption growth likely, but with potential short term hurdles

Copper looks likely to enter a strong demand phase over the outlook period, supported by both the post-COVID-19 economic recovery and the long term transition to renewable energy technology and battery storage. A US$1.2 trillion infrastructure package passed by the US Congress in November 2021 will also have positive effects on copper demand.

Copper consumption will face some barriers in the short term. First, high energy prices and episodes of power rationing in China may cause manufacturing to be slower than it might have been otherwise. Second, if inflation pressures are sustained, central banks may tighten monetary policy, softening copper demand. Third, high prices and decreasing availability may moderate copper demand in the short term.

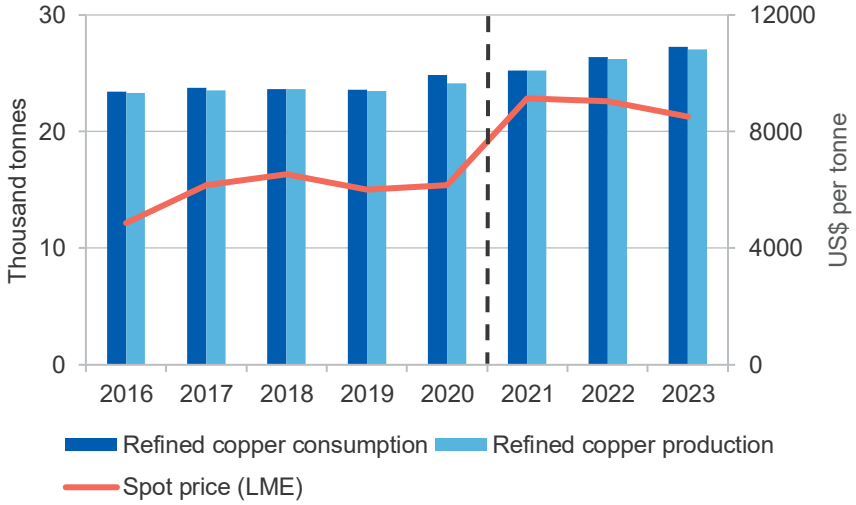
Refined copper consumption is expected to increase 3.7% to reach over 25 million tonnes in 2021 — an increase on 2020 consumption, but lower than forecast in the September 2021 *Resource and Energy Quarterly (REQ)*. Total world consumption is forecast to reach 27 million tonnes in 2023 as manufacturers fulfil a backlog of demand (Figure 12.1).

China's consumption provides significant support to the copper market

China accounted for more than half (54%) of global refined copper consumption in 2020 (Figure 12.2), in addition to being the largest refiner of copper (42%). This position at the heart of the global copper market makes China highly influential with regard to global copper prices and investment decisions.

Episodes of power rationing have seen demand for mined and intermediate products weaken in the September quarter 2021, while uncertainty in the property market has seen the demand for refined copper soften. The construction sector accounts for 20% of end-use demand, with concerns surrounding the sector unlikely to be resolved by the end of the December quarter 2021. Fortunately, fears of a renewed wave of COVID-19 infections in the September 2021 *REQ* have not been borne out, as containment measures proved effective in preventing the outbreak from spreading to other provinces.

Figure 12.1: World balance of refined copper market



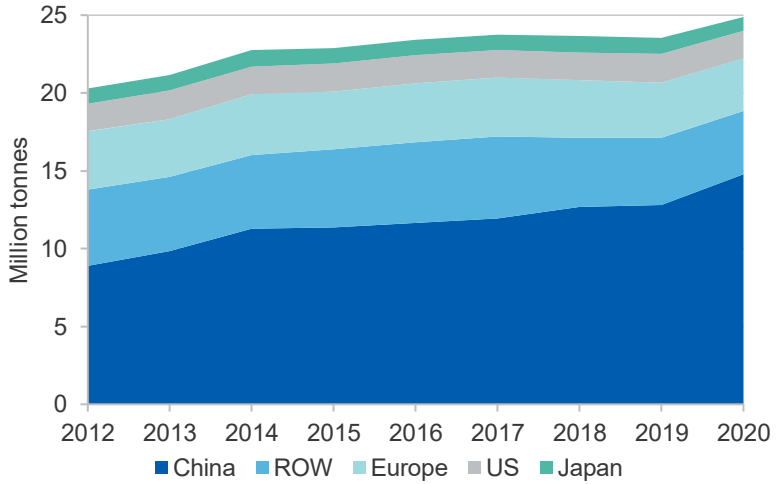
Source: LME (2021) official cash price; World Bureau Metal Statistics (2021); Department of Industry, Science, Energy and Resources (2021)

2021 growth led by ex-Chinese demand

Fiscal stimulus packages, COVID-19 containment measures, pent-up consumer demand and low interest rates have supported growth in ex-China copper demand in 2021. Refined copper usage in the US is expected to increase by 11% this year, while European copper demand is expected to bounce back to the strong levels seen in the first six months of 2021 (after recent flooding events). Medium-term prospects for copper have also been buoyed by the EU's decarbonisation targets. Growth in Asia has also been strong, however reductions in automotive manufacturing pose a downside risk, as shortages of semiconductors have forced manufacturers to reduce monthly production by between 10% (Honda) and 30% (Nissan).

Supply issues mean that copper use has been limited throughout the second half of 2021; however, medium-term demand is expected to be strong, as manufacturers meet backorders. The market is expected to continue to experience tightness over the outlook period given the rundown of exchange inventories (see *Prices* section).

Figure 12.2: Refined copper consumption by major market



Source: World Bureau of Metal Statistics (2021); Department of Industry, Innovation and Science (2021)

12.3 World production

World production to grow, despite constraining factors

Mine production is forecast to reach 24 million tonnes in 2023, up from about 22 million tonnes in 2021, as high prices and expectations of future demand growth create strong incentives for development projects. Long project development timelines may result in production taking until 2023 to come online — leaving the copper market in deficit in 2022. Over the outlook period the largest production increases are expected to come from Peru and Chile (Figure 12.3), though both countries face some short-term issues in bringing product to export markets.

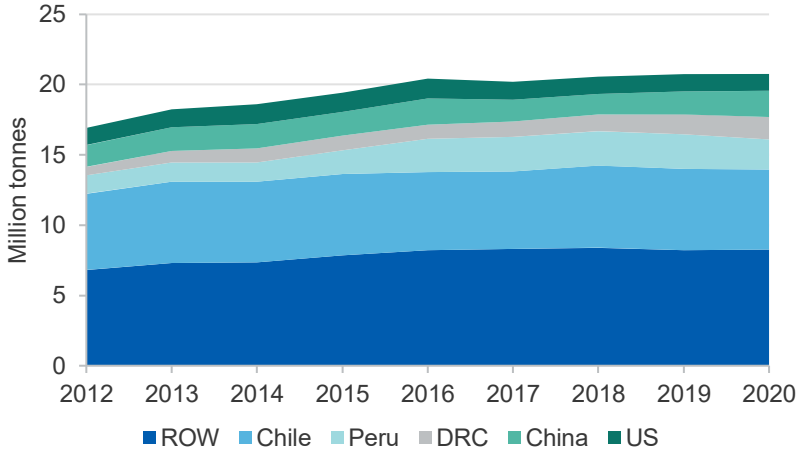
Growth is also expected in Russia, with a Russian and Kazakhstani joint development finalising an agreement to mine the large Tarutinsky copper deposit in Russia's Chelyabinsk region. The mine is expected to yield a capacity of 750,000 tonnes per year, over a 9.5 year mine life, and is expected to be largely directed to export markets.

Uncertainty around Chile and Peru production

Mine production in Peru improved by 6.9% quarter-on-quarter in the September quarter 2021. However, ongoing protest activities are occurring at several mines including at MMG's Las Bambas mine, which is one of the world's largest copper mines. The mine has faced environmental issues due to heavy traffic imposed on local roads and the spread of mineral dust, which has been identified as a risk to agriculture in the region. MMG have stated that negotiations around the November blockade have failed, and that Las Bambas will cease production from mid-December. Even accounting for mine disruptions, significant growth in mine production is expected from Peru through to 2023.

In Chile, production fell by 2.5% in the September quarter 2021. Production at BHP's Escondida mine continues to decline quarter-on-quarter due to lower feed grade, however the company successfully negotiated collective bargaining arrangements which had threatened to affect production through protest action. Mine production for 2021–22 is estimated at around 1 million tonnes.

Figure 12.3: Mined copper production by major producers



Source: World Bureau of Metal Statistics (2021); Department of Industry, Innovation and Science (2021)

Strong momentum in refined production growth

After rising by 2.8% in 2020, refined copper production is estimated to grow by 4.4% in 2021 to 25 million tonnes (Figure 12.4), as new Chinese refining capacity comes online, and as high prices encourage increased processing. Refined production is expected to grow to 27 million tonnes in 2023. This is expected to match copper consumption and thus stabilise inventories — and in turn reduce some of the upward price pressure in the global copper market.

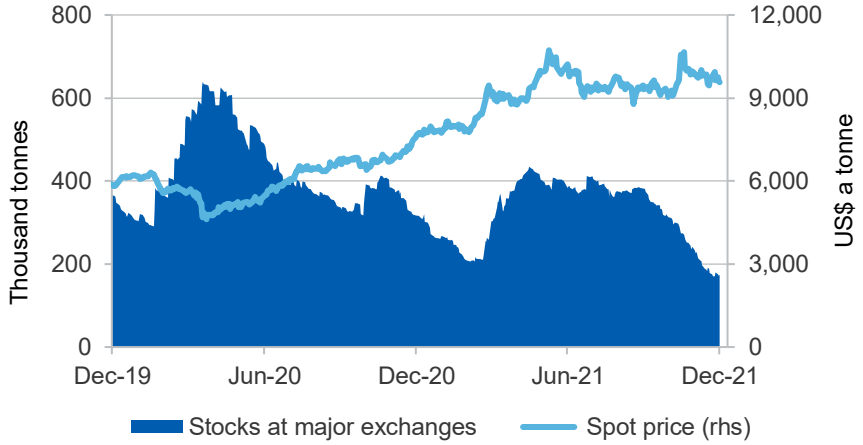
There remain some downside risks to production growth, which could potentially prevent any significant price easing over the next two years. Chinese copper production fared fairly well through episodes of power rationing in the September quarter 2021, mainly due to its relatively low energy intensity and its importance to low emissions technology. While some refineries were affected through October and November, the effects are much less than those seen in aluminium or nickel production. Modest power rationing is expected to continue into the March quarter 2022, although it is unclear to what extent copper production will be impacted.

12.4 Prices

Copper prices remain elevated but volatile

Copper prices briefly reached US$10,452 a tonne in October, just under the record level set in May this year (US$10,720 a tonne). Declining LME copper inventories are the driving factor for this increase in the copper price. The LME instituted special temporary measures to ensure liquidity and regulate prices from 19 October 2021. These measures have had the intended effect, with prices softening to around US$9,500 a tonne by the end of October and into November (Figure 12.4).

Figure 12.4: Exchange inventories of copper vs price



Source: LME (2021) official cash price; Bloomberg (2021)

Prices are expected to remain high in 2022 — at around $US9,000 a tonne — as refined producers fill the current backlog of orders, the rollout of US infrastructure projects gets underway and the Chinese property sector stabilises. With high prices for copper, there may be some thrifting and substitution. Easing of China's restrictions on copper scrap imports will help, as will clarification that the EU's Circular Economy Action Plan will not impose a blanket ban on copper scrap exports.

It is expected that significant additional mine supply will come online in 2023, helping moderate the copper price to US$8,500 a tonne. However, any delay to mine production coming online could see this easing of prices fail to materialise.

Macroeconomic factors pose a risk over the outlook period; if inflation does not prove to be transitory, governments may seek to tighten fiscal and monetary policy, reducing copper demand.

It remains unclear how long the temporary measures instituted by the LME will stay in place, although there is likely to be little appetite to remove them when prices remain high and stocks remain low.

While China released strategic reserves of copper in July to cool prices, it may not have the capacity nor desire to do so again if prices start to rise.

12.5 Australia

Price growth is providing strong revenue to exporters

Export earnings lifted from $10.2 billion in 2019–20 to $11.4 billion in 2020–21. Earnings are expected to rise further over the forecast period, to $14.7 billion by 2022–23 (Figure 12.5). This is expected to be achieved through the retention of some of the price surge recorded in late 2021, as well as export volume growth in 2022–23 as production ramps up after scheduled maintenance at several sites.

Copper export volumes to grow over outlook period

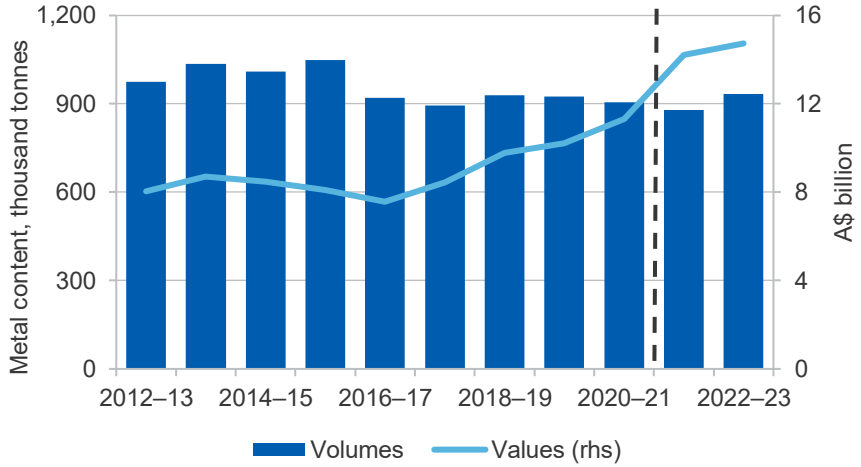
Copper export volumes are recovering from a brief fall brought about by planned maintenance at BHP's Olympic Dam facility. Capacity upgrades under consideration at the site are expected to support a lift in export volumes over the outlook period. Australian exports of ores and concentrates are expected to rise from 1.7 million tonnes in 2020–21 to 1.8 million tonnes by 2022–23.

Copper production down before new capacity comes online

Mine production has been affected by lower processing rates and scheduled maintenance at a number of sites. However, a recovery is expected over the outlook period, with mine production forecast to grow from 878,000 tonnes in 2020–21 to 904,000 tonnes in 2022–23.

Over the next few years, copper exports are expected to be supported by a number of project developments. These include Golden Cross Resources' Copper Hill project, KGL Resources' Jervois project and Havilah Resources' Kalkaroo project, which are all under development.

Figure 12.5: Australia's copper export volumes and values



Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

The Nifty copper mine in Western Australia has been acquired by Cyprium, after being placed on care and maintenance in 2019. The new owners noted in their 2020 Annual Report that the processing method is expected to change to heap leaching to produce copper metal plate. Under this model, annual capacity is 20,000 tonnes, and Cyprium is targeting first production at the end of 2022.

Olympic Dam copper production decreased by 43% to 30,000 tonnes, reflecting the ramp down and commencement of a major smelter maintenance campaign (approximately one month later than planned, due to COVID-19 border restrictions impacting the availability of workforce).

The maintenance campaign is expected to be completed towards the end of the December 2021 quarter, followed by a ramp up to full capacity by March 2022.

Copper production was also affected at Newcrest's Cadia mine in NSW, as mill capacity was limited by the replacement and upgrade of the SAG mill motor.

Oz Minerals made a FID on the Wira shaft mine expansion at Prominent Hill. The $600 million expansion extends the mine life out to 2036, raising copper in concentrate production 23% to 53,000 tonnes annually.

Copper exploration picks up in September quarter 2021

Copper exploration reached $122 million in the September 2021 quarter, up 1.8% quarter-on-quarter and 61% year-on-year. Recent high prices have improved the prospects for most copper projects and encouraged exploration to identify new ones.

Revisions to the outlook

Export earnings for 2022–23 have been revised up by slightly to $14.7 billion since the September *Resource and Energy Quarterly*. This is largely a result of upwards revisions to copper export volumes.

Table 12.1: Copper outlook

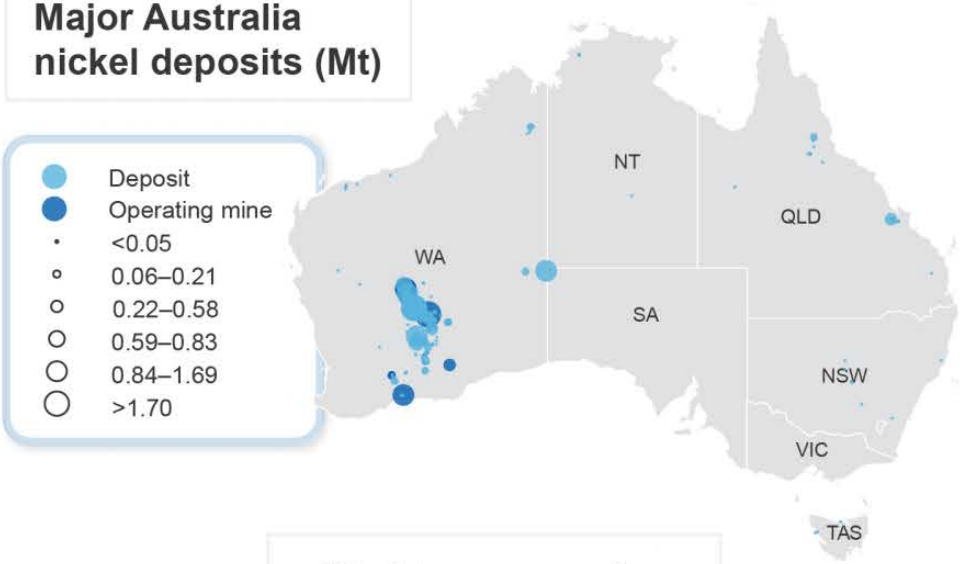
						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021[f]**	**2022[f]**	**2023[f]**
Production								
– mine	kt	20,670	21,694	22,655	23,698	5.0	4.4	4.6
– refined	kt	24,122	25,183	26,228	27,041	4.4	4.1	3.1
Consumption	kt	24,885	25,797	26,396	27,276	3.7	2.3	3.3
Closing stocks	kt	1 315	1 148	1 064	975	-13	-7.3	-8.4
– weeks of consumption		2.7	2.3	2.1	1.9	-16	-9.4	-11
Prices LME								
– nominal	US$/t	6,169	9,228	9,039	8,518	50	-2.0	-5.8
	USc/lb	280	419	410	386	50	-2.0	-5.8
– real[b]	US$/t	6,396	9,228	8,737	8,019	44	-5.3	-8.2
	USc/lb	290	419	396	364	44	-5.3	-8.2
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21[s]**	**2021–22[f]**	**2022–23[f]**
Mine output	kt	905	878	878	904	-3.1	0.0	3.0
Refined output	kt	421	452	442	444	7.6	-2.4	0.6
Exports								
– ores and concs[c]	kt	1,899	1,678	1,656	1,803	-11.6	-1.3	8.8
– refined	kt	392	420	407	429	7.2	-3.2	5.3
– total metallic content	kt	924	898	880	934	-2.9	-1.9	6.0
Export value								
– nominal	A$m	10,208	11,446	14,164	14,734	12.1	23.8	4.0
– real[d]	A$m	10,625	11,723	14,164	14,423	10.3	20.8	1.8

Notes: **b** In 2021 calendar year US dollars; **c** Quantities refer to gross weight of all ores and concentrates; **d** In 2020–21 financial year Australian dollars; **f** Forecast; **s** Estimate;

Source: ABS (2021) International Trade, 5465.0; LME (2021) spot price; World Bureau of Metal Statistics (2021) World Metal Statistics; Department of Industry, Science, Energy and Resources (2021)

28 Ni 58.693 Nickel

Major Australia nickel deposits (Mt)



Nickel facts

- Nickel is used in the **US, UK and Euro coins**
- Nickel has a growing role in **electric vehicle batteries**
- Nickel is **magnetic** at room temperature and is **fully recyclable**
- Nickel is the **second most abundant element** in the Earth's core after iron

World consumption

- **70%** Stainless steel
- **8%** Alloys
- **8%** Plating
- **8%** Casting
- **5%** Batteries
- **1%** Other

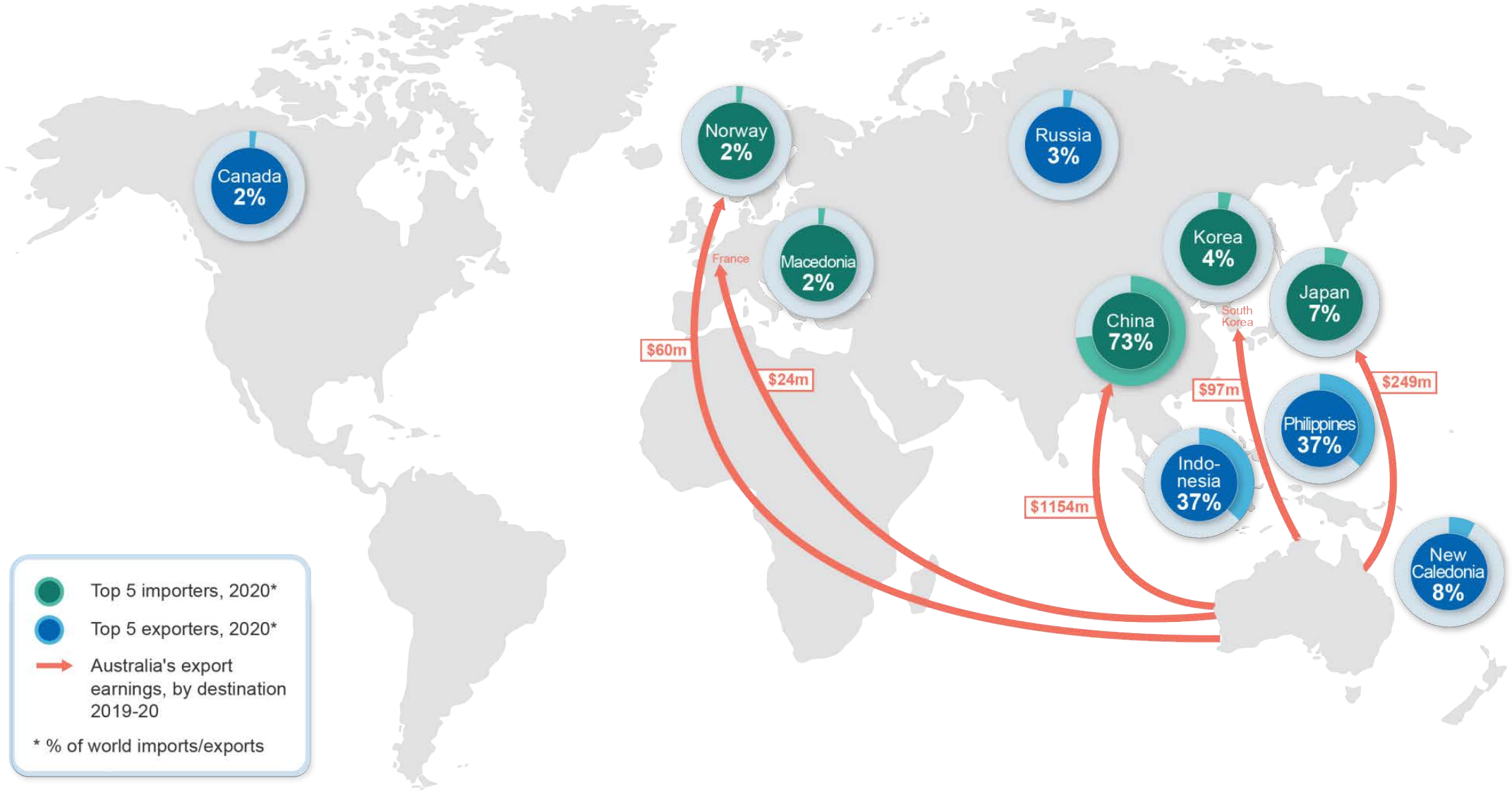
Australia's nickel

- Australia has **26%** of world **nickel resources**
- **Typically produces over 200,000 tonnes** a year
- **Contributes more than $3b** to the economy

Nickel

28 Ni 58.693

Trade map | December 2021



13.1 Summary

- The nickel price is estimated to average US$18,388 a tonne in 2021, 34% higher than in 2020. Strong demand in stainless steel usage and electric vehicle batteries drove early gains, and supply-side shocks propelled subsequent gains.
- New projects and expansions are expected to lift Australia's export volumes from an estimated 181,000 tonnes in 2020–21 to about 272,000 tonnes in 2022–23 (*see Australia section)*.
- Australia's nickel export earnings are forecast to rise on the back of growing export volumes and higher prices, reaching $5.2 billion in 2021–22 and $4.8 billion in 2022–23, up from $3.8 billion in 2020–21.

13.2 World consumption

Nickel consumption growth stumbles

Global nickel consumption grew by 14% year-on-year in the September quarter 2021 as the industry continues to rebound following the COVID-19 pandemic. However, episodes of power rationing in China have contributed to a 3.3% quarter-on-quarter decline in nickel consumption in the September quarter — with consumption likely to be subdued into the December quarter as well. Despite this, global finished nickel demand is still estimated to reach 2.8 million tonnes in 2021, up 16% from 2020. Demand is expected to continue to grow, hitting 2.9 million tonnes in 2022, and 3.1 million tonnes in 2023.

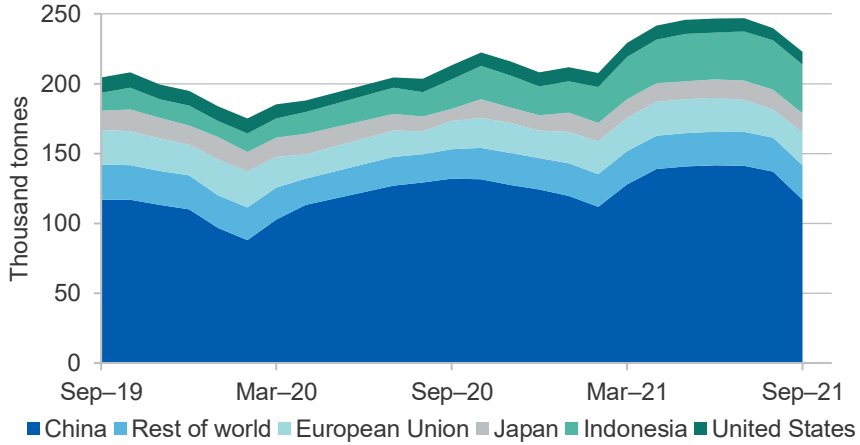
Nickel will be of growing importance to the global supply chain. The United States Geological Survey (USGS) has added nickel to its critical minerals list for 2021. Nickel's addition to this list offers miners access to US government subsidies, encouraging greater supply. It is expected that these effects will be felt beyond the forecast period.

Power rationing a hurdle to stainless steel's rebound

Stainless steel still constitutes the majority of global nickel demand, despite the burgeoning electric vehicle (EV) sector. China thus remains crucial to nickel markets, since it produces close to 60% of the world's stainless steel output. However, power rationing has significantly decreased Chinese stainless steel output, with monthly output being approximately 330,000 tonnes — or 24% — lower than expected in September. This decreased output implies a drop in demand of around 26,000 tonnes of nickel for the month of September alone (Figure 13.1). Data for October suggests demand will be equally subdued through the December quarter. With energy demand set to remain high as the Northern Hemisphere winter begins, it is plausible that power rationing may continue to be a feature of the Chinese economy as 2022 begins, constraining stainless steel output in the first half of 2022 at least.

In spite of China's production problems, global stainless steel production in 2021 is still forecast to be 14% higher than in 2020, largely supported by government stimulus spending and strong Chinese production in the first half of 2021. Global growth in stainless steel production is expected to moderate to 6% in 2022 and 4% in 2023 (Figure 13.2). This growth is expected to be driven by expansions from Delong (Indonesia) and Tsingshan (China), while stainless steel production is set to remain relatively stable in the US, Europe, Japan and Taiwan.

Figure 13.1: Refined nickel consumption by major country



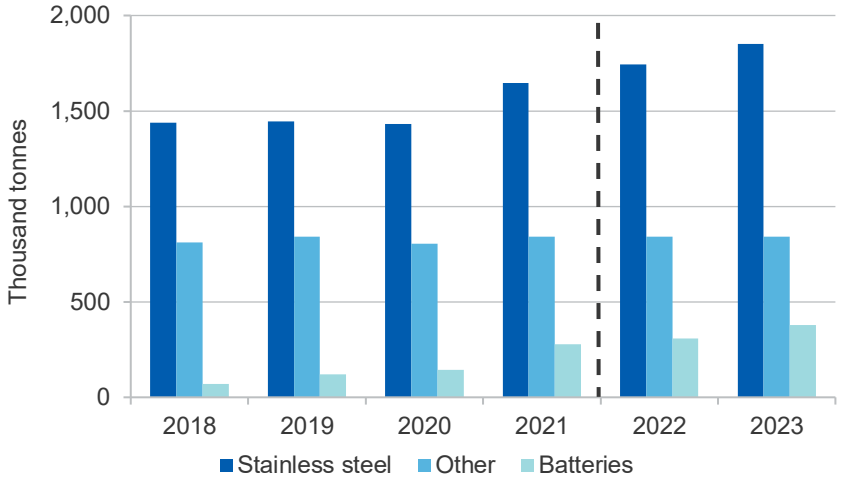
Source: International Nickel Study Group (2021), Department of Industry, Science, Energy and Resources (2021)

Expectations of future consumption growth driven by the battery sector

Accelerating demand for EVs — as part of global moves towards decarbonisation — is driving rising demand for nickel. Nickel use in battery precursors is forecast to increase by 60% to 280,000 tonnes globally in 2021, with China accounting for 75% of this demand.

Use in battery precursors accounted for about 6% of primary nickel consumption in 2020. However, rising EV penetration rates, combined with increased use of nickel in batteries, is projected to see this contribution reach 12% by 2023. This will likely be driven by demand in the EU, China and the US in the short term, while local EV value chains in populous nations such as India and Indonesia are likely to drive consumption beyond the forecast period. Also pointing to the growing importance of nickel in the EV supply chain, several supply deals were struck between refined nickel producers and automotive and battery manufacturers, including BHP's Nickel West deal with Prime Planet Energy & Solutions' (PPES) to supply Nickel Sulphate (see *Australia section*).

Figure 13.2: Forecast nickel consumption by use



Source: International Nickel Study Group (2021), Department of Industry, Science, Energy and Resources (2021), BloombergNEF (2021)

13.3 World Production

Global nickel production set to increase in 2021

Global mined nickel production is estimated to rise by 10% year-on-year to 2.7 million tonnes in 2021, as production ramps up in Indonesia and returns to pre-COVID-19 levels in other regions. Mine production increased by 12% year-on-year in the September quarter 2021, while refined production increased 4.5% year-on-year. In 2021, refined nickel production is expected to increase by 10% to 2.6 million tonnes.

Indonesian nickel mining has largely returned to pre-COVID-19 pandemic levels, and continues to grow. In the September quarter 2021, Indonesian mine production was up 3.9% quarter-on-quarter and 29% year-on-year.

Mining has been halted at Vale's Onça Puma operations in Brazil, after an injunction was brought against them by the state's environmental agency in October. This will affect December quarter 2021 production.

Canadian refined output fell 18% quarter-on-quarter, mainly owing to protest action at Vale's Sudbury operations. The protests occurred for a total of 70 days, of which 40 were in the September quarter, and reduced finished nickel output by 11,000 tonnes in the September quarter 2021.

Production in the Philippines continues its significant rise. Mine production increased 26% quarter-on-quarter in September quarter 2021, after more than doubling quarter-on-quarter in the June quarter 2021. This rise is despite the continuation of the ban on new open cut mines.

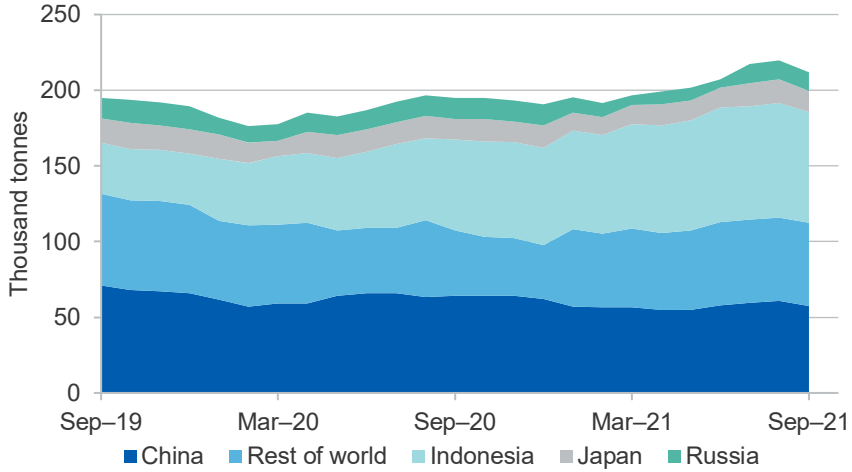
Russian mine production rebounded to pre-COVID-19 levels in the September quarter 2021, after a slow start in the first half of 2021. Norilsk Nickel completed the recommencement of its Russian operations, with production expected to return to full capacity in December. Consolidated nickel output (refined and intermediate products) was 43,000 tonnes for the quarter — an increase of 80% from the June quarter.

World mine production is expected to increase by 7.7% in 2022 and 9.3% in 2023, largely driven by increased mine production in Indonesia.

Rising cost affecting refined nickel production

Rising costs have significantly curtailed refined nickel production in China. Refined nickel production is energy intensive, and as rising energy costs cut profitability, finished nickel production in 2021 is expected to be 6.6% lower than in 2020 (which was already lower than the preceding year due to the COVID-19 pandemic). Costs pressures have also come from rising ore costs, as lower shipments from the Philippines (disrupted by seasonal monsoons) force higher competition for cargoes. Scrap usage has risen by about 5% in China, in an effort to reduce the need for primary nickel.

Figure 13.3: Refined nickel production by major country



Source: International Nickel Study Group (2021), Department of Industry, Science, Energy and Resources (2021)

Indonesian nickel pig iron (NPI) costs have also risen sharply in line with input costs, with the price of energy having risen 50% over the last year. However, Indonesian producers have access to local nickel ore supply at a government-regulated price. Despite global cost pressures, Indonesia's refined nickel production rose by 33% year-on-year in the September quarter 2021. Production is coming from NPI and high pressure acid leach (HPAL) operations (Figure 13.3). Lygend, a Chinese company, is adding to NPI production, with 20 production lines planned and first production expected in early 2022.

HPAL producers are also seeing significant cost pressures, due to higher sulphur costs. Quantum's Ravensthorpe HPAL plant saw its pre-cobalt credit cash costs rise to $22,751 per tonne — an annual rise of two thirds.

13.4 Prices

Prices have been volatile in the September quarter

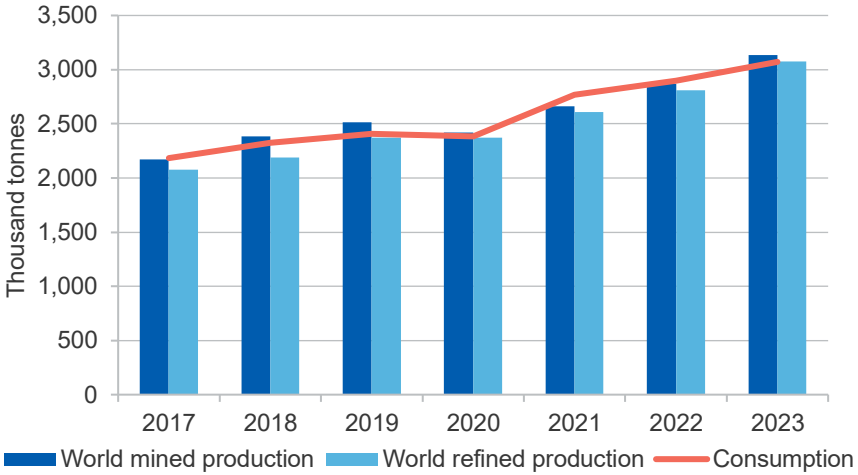
Nickel prices were volatile in 2021, with prices peaking at almost US$20,000 a tonne in mid-February 2021, falling to $17,320 a tonne in the June quarter 2021 and then rebounding to average $19,125 a tonne in the September quarter 2021 (Figure 13.5). Prices averaged around US$19,500 a tonne in the December quarter — a figure which hides significant price fluctuations within the quarter. Prices were significantly affected by power rationing in China — on both the demand and supply side — in the December quarter 2021. Initially, weaker demand from stainless steel makers saw prices fall to US$18,000 a tonne. However, the decline in refined nickel supply has now far outweighed the decrease in nickel demand, creating upward pressure on the nickel price. As a result, the nickel price reached a 7-year high of US$21,046 a tonne in October. Rumours about a potential export ban on various nickel products by the Indonesian government have also created uncertainty, and pushed prices up.

Elevated prices are expected to be supported through the continued proliferation of EVs into the global market. Non-stainless steel demand (primarily batteries, including those used in EVs) is expected to grow by 7.3% annually. Nickel supply — especially for EVs in the form of nickel chemicals — remains tight, with some market participants finding supplies difficult to source in the second half of 2021. That said, there remains some downside risks if the semiconductor chip shortage continues and forces temporary shutdowns in automotive manufacturing plants. Volkswagen has announced it has shut two EV plants for a week in

November, affecting 5,000 vehicles, while Tesla has pushed delivery for new Model S and Model X orders out to the March quarter 2023.

Nickel prices are expected to ease to about US$18,600 a tonne in 2022 and US$17,200 a tonne in 2023, as power rationing eases, which will lift supply to around the same level as demand (Figure 13.4).

Figure 13.4: World nickel production and consumption



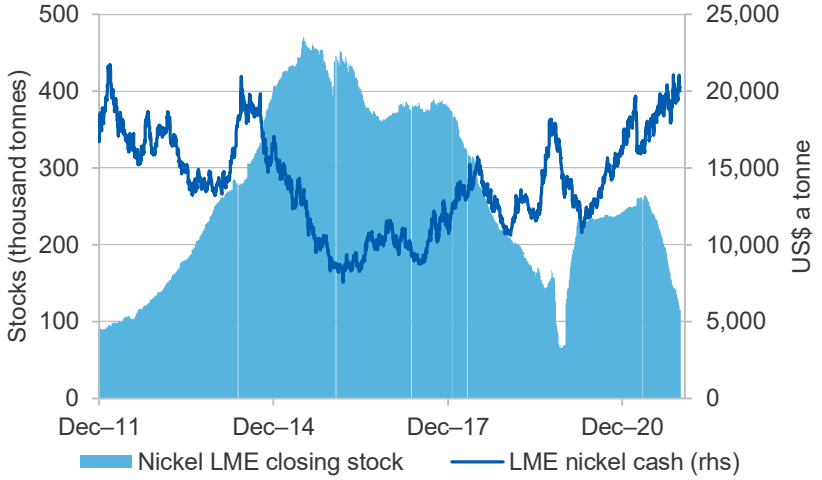
Source: International Nickel Study Group (2021), Department of Industry, Science, Energy and Resources (2021)

13.5 Australia

Export earnings to grow

In 2020–21, nickel export earnings were $3.8 billion, roughly the same as in the previous year (Figure 13.6). Over the outlook period, export earnings are forecast to reach $5.2 billion in 2021–22 and $4.8 billion in 2022–23. Export earnings growth is based on rising output — as operations restart and new capacity comes online — spurred by strong nickel prices, as the battery sector expands. Export volumes are forecast to total 257,000 tonnes in 2021–22 — up 42% year-on-year — and to climb to 272,000 tonnes in 2022–23.

Figure 13.5: Nickel price and stock levels



Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2021)

Expectations of market growth support openings and restarts

The battery sector continues to grow, with global EV sales expected to rise to over 5 million vehicles in 2021 (see *lithium* chapter). This is expected to keep nickel price growth strong in the short term.

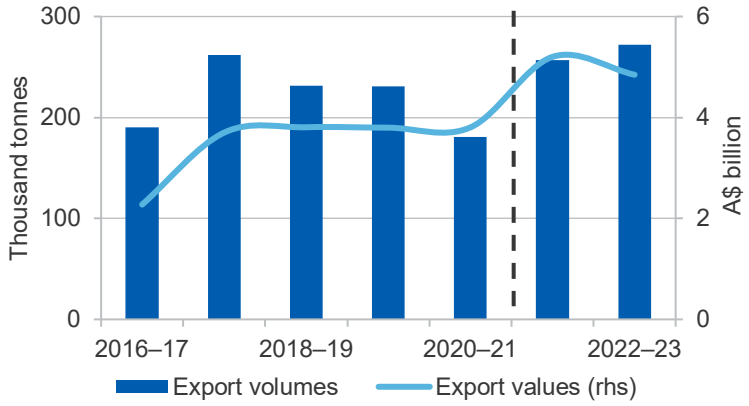
Panoramic Resources has begun mining and developing the Savannah nickel project in Western Australia (WA). The mine has produced its first concentrate, with the first shipments expected in December 2021. Average annual output of 9,100 tonnes of nickel is planned.

Poseidon Nickel has stated it may make a FID on Golden Swan by the end of 2021, with production possible by the December quarter 2022. This follows upgrades to its contained resources. Mincor have issued a start notice for an offtake and processing agreement with BHP for its Kambalda Nickel Operations (KNO), with first concentrate sales expected in June quarter 2022 — a quarter later than planned, due to labour shortages in WA. Production at Nova decreased by 13% quarter-on-quarter — to 6,889 tonnes — due to an expected decrease in feed grades and recoveries. Output at Forrestania in WA was 3,741 tonnes, down 24%

quarter-on-quarter, due to the mining of lower ore grades. Western Areas' Odysseus produced its first ore in October, and is undertaking an offtake tender process for the sale of its concentrate, which is expected for the December quarter 2022.

Australia's mine production is forecast to lift from 162,000 tonnes in 2020–21 to 219,000 tonnes in 2022–23. Output during the 2019–20 to 2021–22 period has been impacted by Ravensthorpe's entry, closure and re-entry.

Figure 13.6: Australia's nickel export volumes and values



Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Significant potential exists in battery chemicals capacity

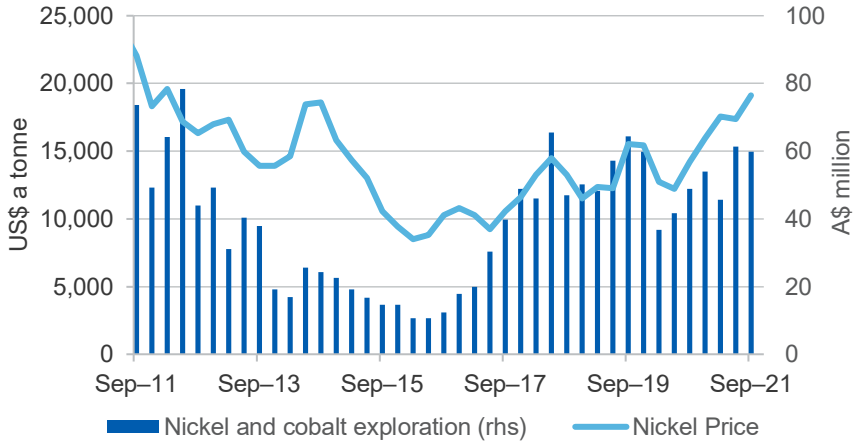
Australia's refinery output is forecast to rise from 105,000 tonnes in 2020–21 to 129,000 tonnes in 2022–23. First Quantum has lowered its guidance for 2021 to 17,000–20,000 tonnes of nickel, due to both equipment delays for its Ravensthorpe operation in WA, as well as the impacts of COVID-19 travel restrictions and higher (sulphur) production costs. Production for the September quarter 2021 was 4,248 tonnes of nickel. First Quantum have completed an agreement for POSCO to secure 7,500 tonnes of nickel in a mixed nickel-cobalt hydroxide precipitate from 2024; enough for 180,000 electric cars a year.

Quarterly output at BHP's Nickel West operations in WA was steady at about 14,400 tonnes of nickel in the September quarter 2021. Nickel West produced its first nickel sulphate crystals in the September quarter 2021, with saleable production expected in December quarter 2021. Production capacity of 100,000 tonnes of nickel sulphate per annum is expected when fully operational. BHP has signed a Memorandum of Understanding (MoU) with Prime Planet Energy & Solutions (PPES) and Toyota Tsusho Corporation (TTC) to deliver nickel sulphate from its Nickel West facility.

Exploration expenditure

In the September quarter 2021, nickel and cobalt exploration fell slightly to $60 million — down 2.4% on the previous quarter but up 22% year-on-year (Figure 13.7).

Figure 13.7: Australia's nickel and cobalt exploration expenditure



Source: ABS (2021) Mineral and Petroleum Exploration, Australia, 8412.0

Revisions to the outlook

Australia's nickel export earnings forecasts have been revised up from the September 2021 *Resources and Energy Quarterly*, due to minor upward revisions to the nickel price.

Table 13.1: Nickel outlook

						Annual percentage change		
World	**Unit**	**2020**	**2021[f]**	**2022[f]**	**2023[f]**	**2021[f]**	**2022[f]**	**2023[f]**
Production								
– mine	kt	2,419	2,663	2,868	3,134	10.1	7.7	9.3
– refined	kt	2,372	2,611	2,812	3,074	10.1	7.7	9.3
Consumption	kt	2,385	2,767	2,896	3,072	16	4.7	6.1
Closing stocks	kt	647	491	408	410	-24.0	-17.0	0.6
– weeks of consumption		14.1	9.2	7.3	6.9	-34	-20.7	-5.2
Prices LME								
– nominal	US$/t	13,769	18,388	18,596	17,184	33.5	1.1	-7.6
	USc/lb	625	834	843	779	33.5	1.1	-7.6
– real [b]	US$/t	14,276	18,388	17,975	16,179	28.8	-2.3	-10.0
	USc/lb	648	834	815	734	28.8	-2.3	-10.0
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Production								
– mine [c]	kt	161	162	195	219	0.6	20.3	12.7
– refined	kt	108	105	121	129	-2.5	15.0	7.1
– intermediate		15	29	29	30	89.1	-2.6	6.4
Export volume [d]	kt	231	181	257	272	-22	42.0	5.8
Export value								
– nominal value	A$m	3,798	3,804	5,201	4,846	0.1	36.7	-6.8
– real value [e]	A$m	3,953	3,896	5,201	4,744	-1.5	33.5	-8.8

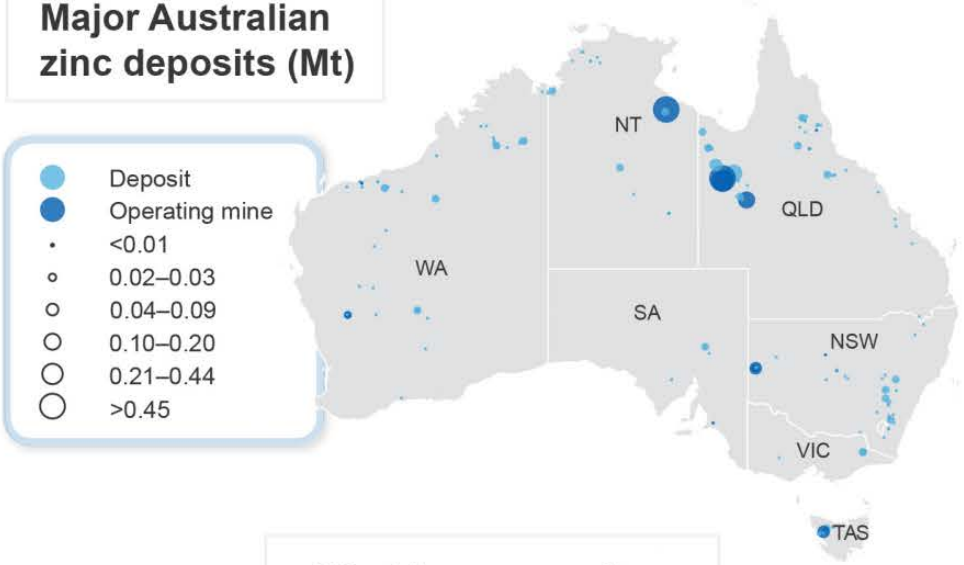
Notes: **b** In 2021 calendar year US dollars; **c** Nickel content of domestic mine production; **d** Includes metal content of ores and concentrates, intermediate products and nickel metal; **e** In 2021–22 financial year Australian dollars; **f** Forecast .

Source: ABS (2021) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Company reports; Department of Industry, Science, Resources and Energy (2021); International Nickel Study Group (2021); LME (2021); World Bureau of Metal Statistics (2021)

30
Zn
65.38

Zinc

Major Australian zinc deposits (Mt)



Zinc facts

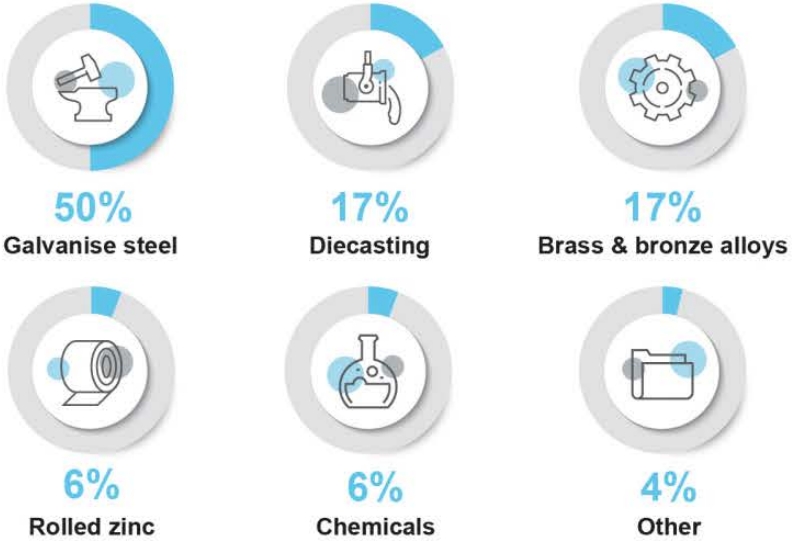
Zinc ore was used in ancient Greece to produce brass

Zinc is used by the human body to **fight infection**

Zinc is used in wound-care and sunscreen

Zinc is an **emerging battery mineral**

World consumption



Australia's zinc

3rd highest producer of zinc in the world in 2020

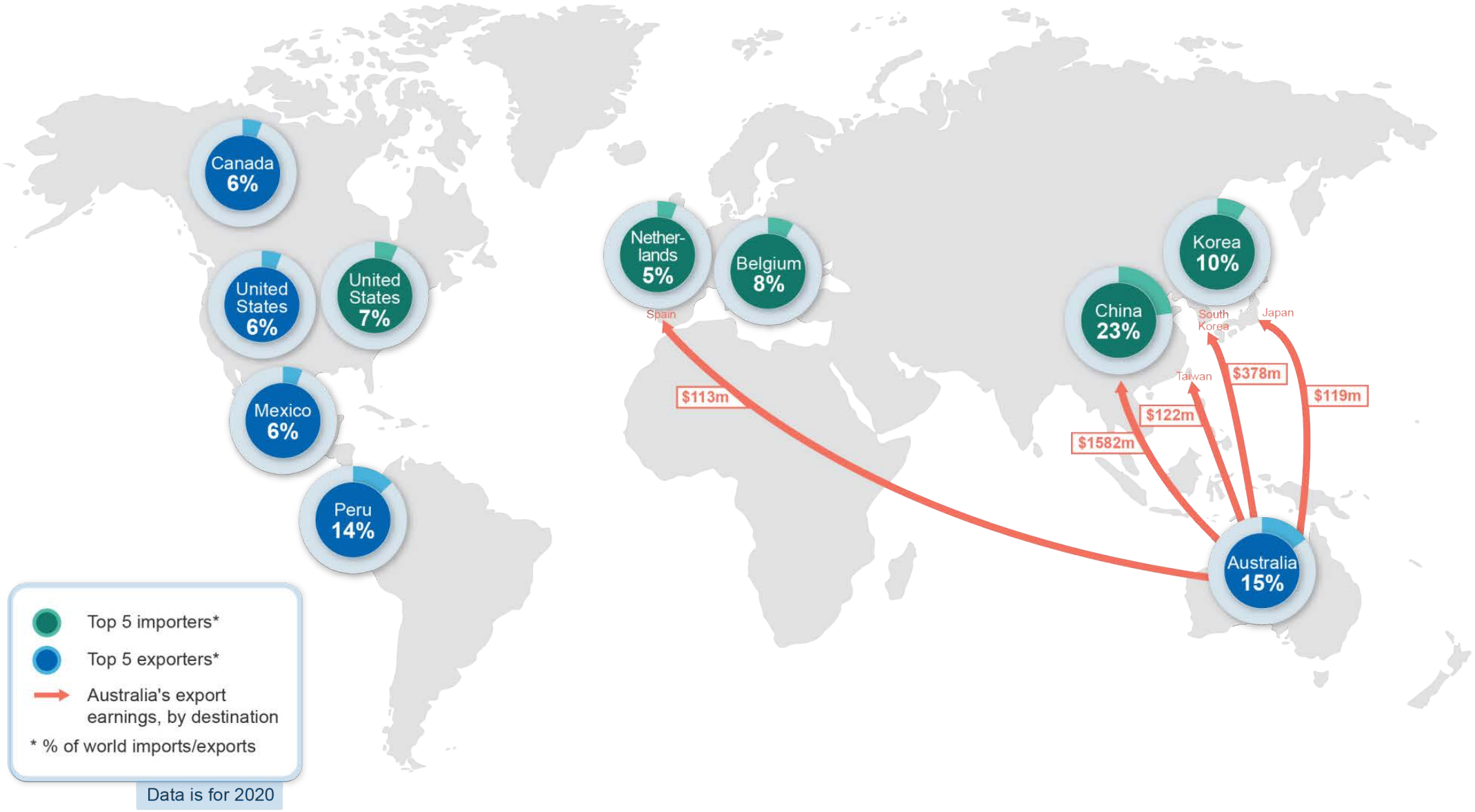
One of world's **top zinc exporters** in 2020

Holds **29% of world zinc resources**

Zinc

30 Zn 65.38

Trade map | December 2021



14.1 Summary

- The LME zinc spot price is forecast to average US$2,990 a tonne in 2022, with government infrastructure programs helping to support prices. Prices are expected to fall to around US$2,675 a tonne in 2023, as production increases and consumption growth normalises.
- Australia's zinc production is forecast to increase from an estimated 1.3 million tonnes in 2020–21 to 1.4 million tonnes in 2022–23.
- Australia's zinc export earnings are forecast to increase from $3.3 billion in 2020–21 to around $4.1 billion in 2021–22, and to $3.6 billion in 2022–23. Rising refined production is expected to offset the impact of lower prices.

14.2 World consumption

Infrastructure spending promises to boost zinc consumption

World refined zinc consumption increased by 5.4% year-on-year in the September quarter 2021. China's consumption decreased by 0.6% year-on-year, while ex-Chinese consumption increased by 12% year-on-year. This saw the world refined metal balance decrease to a barely positive position in the September quarter 2021.

Changes in zinc consumption correlate well with the world industrial production (IP) cycle (Figure 14.1) and with steel production because of its primary role in galvanising steel, both of which grew strongly in 2021 (Figure 14.2). Global automotive sales for the September quarter 2021 decreased by 15% quarter-on-quarter and by 16% year-on-year, as supply chain issues from the impacts of the COVID-19 pandemic continued.

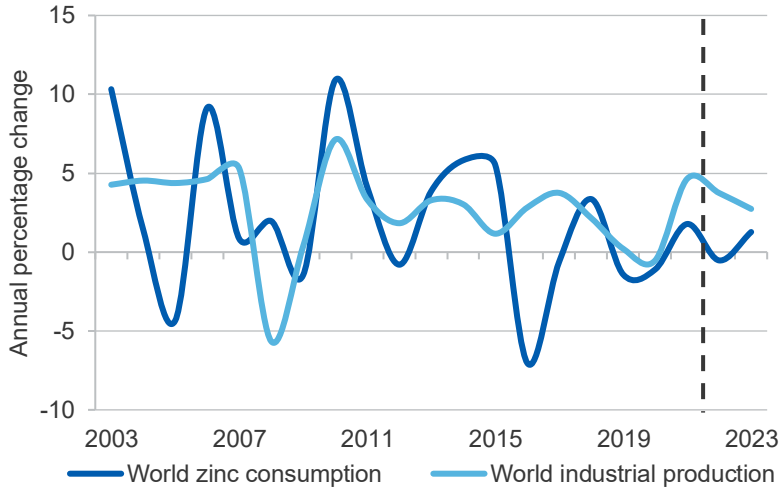
Firm economic growth should see zinc consumption rise modestly over the outlook period, growing from 14.1 million tonnes in 2021 to 14.4 million tonnes in 2023 — up an average of 1.2% a year (Table 14.1). The US$1.2 trillion stimulus package is likely to boost the demand for refined zinc during the outlook period and beyond. Infrastructure spending in India may also grow boosting zinc demand.

Zinc becomes a critical mineral

The US Geological Survey has proposed the US Government place zinc on its critical minerals list. The US has a high reliance on imports for its refined zinc consumption, importing most of its product from Canada and Mexico. Nickel was also recommended by the USGS for placement on the critical minerals list, due to its role in battery production. However, placing zinc on the list also allows for zinc's potential for battery storage, as well as in its traditional use in galvanising steel.

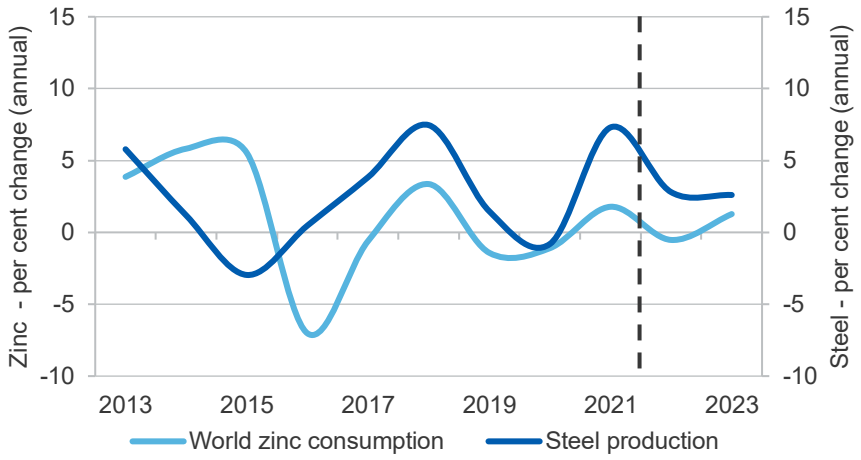
ASX-listed Redflow is continuing its US-focused expansion for zinc bromine batteries. The company anticipates that production of its Gen3 battery will commence in 2022. The company suffered some delays in production at its Thailand base, due to supply chain disruption caused by the COVD-19 pandemic. Canadian Zinc8 has relocated its factory, in order to gear up for commercial production of its zinc air batteries, which the company plans to produce in 2023.

Figure 14.1: World zinc consumption vs industrial production



Source: International Iron and Steel Institute (2021); CPB Netherlands Bureau for Economic Policy Analysis (2021); Department of Industry, Science, Energy and Resources (2021).

Figure 14.2: Steel production vs world zinc consumption



Source: International Iron and Steel Institute (2021); Department of Industry, Science, Energy and Resources (2021).

14.3 World production

Mine production continues to recover from the COVID-19 pandemic

In the September quarter 2021, world zinc mine production decreased by 0.9% quarter-on-quarter but was virtually unchanged from the September quarter 2020. China's mine production decreased by 1.8% in the September quarter 2021 and by 5.3% from September 2020. However, China's year to date production for the 9 months ending September 2021 was up 2.2% compared to the same period in 2020.

Production from Peru decreased by 2.5% quarter-on-quarter and by 0.5% year-on-year, with production of 379,000 tonnes (metallic content) remaining at near-normal levels after the COVID-19-pandemic-affected low of 166,000 tonnes recorded in the June 2020 quarter. Peru's government is considering changes to the mining framework as well as to the legislation to set royalties for mining operations.

In the September quarter 2021, Australia's mined zinc production decreased by 2.3% quarter-on-quarter, but rose by 1.4% year-on-year.

Mine production is expected to rise over the outlook period

World mine output is estimated at 13.0 million tonnes in 2021, and is forecast to rise by 1.0% per year to 13.2 million tonnes by 2023, as new mine capacity raises output (Figure 14.3).

Nexa Resources' Aripuana mine in Brazil, will increase zinc supply once construction is completed, with production expected in 2022. The Juanicipio project in Mexico, operated by Fresnillo Plc, is continuing its development, with possible zinc production in 2022. The mine may produce around 25,000 tonnes of zinc initially, ramping up to 40,000 tonnes a year after 2025.

Production ramp up from Glencore's Zhairem in Kazakhstan is ongoing, with the company expecting steady state by the June quarter 2022.

Vedanta Zinc's Gamsberg mine in South Africa also has finalisation of ramp up to complete. Full capacity is expected in 2023. Asmara in Eritrea, operated by Sunridge Gold, may also see zinc production in 2024, after first mining gold and copper.

World refinery production steady

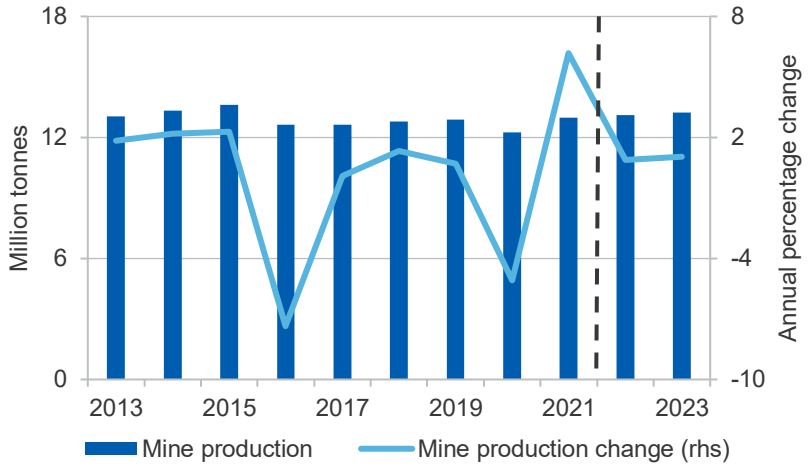
World zinc refined production decreased by 0.3% quarter-on-quarter in the September quarter 2021 and by 0.4% year-on-year. While China's refined metal production decreased by 0.4% year-on-year for the September quarter of 2021, it increased by 2.8% quarter-on-quarter, despite the ongoing power issues.

China's concentrate imports were 30% lower quarter-on-quarter in the September quarter 2021 at 281,000 tonnes, due to ongoing power shortages as well as China's lowering of steel production. In Chinese provinces where zinc is refined, power rationing continues to be a concern, with some provinces ordered to cut power consumption by 20-30%.

Refined production from primary and secondary sources is expected to increase by an average of 1.5% a year over the outlook period, reaching 14.4 million tonnes in 2023.

Based on likely rising Indian infrastructure spending, Vedanta plans to scale up production capacity by 25% over the next 10-15 years. A lift in smelting capacity may follow an expansion in Gamsberg, with additional capacity in India or via a restart of the Skorpian smelter in Namibia.

Figure 14.3: World zinc mine production, metallic content



Source: International Lead Zinc Study Group (2021); Wood Mackenzie (2021); Department of Industry, Science, Energy and Resources (2021).

14.4 Prices

Price increases reflect tightness in supply

Zinc prices averaged US$2,991 a tonne during the September quarter 2021 — up 2.6% quarter-on-quarter and 28% year-on-year. Rising metal consumption, due to spending on infrastructure, is placing upward pressure on prices.

Prices have been supported by cuts in the production of refined zinc, as rising power costs have impacted major refining countries. Spot treatment and refining charges are still low compared with contract treatment and refining charges (year-to-date) at US$159 a tonne, and stable at the same levels over the September 2021 quarter — down from US$300 a tonne in 2020.

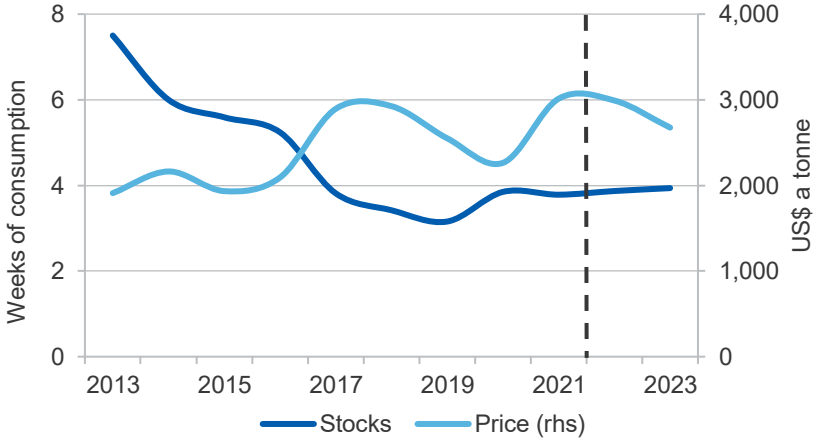
Power rationing and cuts to refined zinc production, combined with a high zinc price are encouraging the miners, and will likely see some appreciation in the treatment charges and perhaps rebalance some of the lost profits of the smelters, who have had to cut production.

In an attempt to push down prices, the Chinese Government released 50,000 tonnes from its strategic reserves at auction in September, after releasing another 50,000 tonnes in late July.

London Metals Exchange (LME) and Shanghai Futures Exchange zinc inventories are around 272,000 tonnes — down from 289,000 tonnes in the June quarter 2021.

The LME zinc spot price is estimated to average US$3,013 a tonne in 2021, decreasing to around US$2,991 a tonne in 2022 and US$2,675 a tonne in 2023, as world production increases (Figure 14.4). Ongoing supply disruptions — such as power shortages at zinc smelters in China, gas supply and high power prices in Europe — would likely support prices. Producers cutting production in Europe due to high gas prices include Glencore and Nystar.

Figure 14.4: Zinc prices and stocks



Source: London Metal Exchange (2021); Department of Industry, Science, Energy and Resources (2021).

14.5 Australia

Export earnings expected to increase before returning to 'baseline'

In 2020–21, Australia's exports of zinc decreased by 9.0% year-on-year to 1.4 million tonnes (in metal content terms), but decreased by 8.1% in value to $3.3 billion with concentrates declining in volume but refined zinc increasing in volume. The decline in concentrates year-on-year for 2020–21 is in part due to a very high volume of exports in 2019–20 compared with 2018–19, as Australia took up volumes that Peru could not supply due to the COVID-19 pandemic. The increase in refined zinc exports reflects expansion at the Sun Metals refinery in Townsville.

Australia's zinc export earnings (for both concentrate and refined metal) are forecast to increase from $3.3 billion in 2020–21 to around $4.1 billion in 2021–22, but decline to $3.6 billion in 2022–23, as rising production (including for refined metal) offsets the impact of lower prices.

Australia's production decreased slightly in the September quarter 2021

In the September quarter 2021, Australia's mined zinc output decreased by 5.9% year-on-year and decreased by 2.5% quarter-on-quarter, largely as a result of decreased production from Mt Isa in Queensland.

Glencore's Australian production decreased by 2.8% year-on-year in the September quarter 2021, with output declining from the Mt Isa and McArthur River operations in Queensland and the Northern Territory. Production declined at McArthur River, from 74,200 tonnes of zinc in concentrate to 69,900 tonnes. Production at Mt Isa was 82,800 tonnes of zinc in concentrate — down from 86,400 tonnes, but broadly similar to the prior year's production.

Production at Century Tailings Reprocessing in Queensland decreased by 14.1% year-on-year in the September quarter 2021, and decreased by 8.9% quarter-on-quarter, after a ball mill bypass during the quarter.

Production at South32's Cannington operation in Queensland increased by 24% year-on-year in the September quarter 2021, and decreased by 21% quarter-on-quarter, with processing of planned lower grades stopes extracted from underground operations, as well as planned surface maintenance. The company has decided to streamline underground extraction using truck haulage instead of truck and shaft, commencing in June 2022.

Output from MMG's Dugald River in Queensland increased by 5.0% year-on-year in the September quarter 2021, after recovering from technical issues and planned maintenance in the previous quarter. At Rosebery in Tasmania, output decreased by 12% year-on-year, due to lower grades as well as lower mining due to a rock-fall causing 'dilution' of the ore.

Refinery and concentrate exports declined

Australia's zinc concentrate exports decreased by 15% quarter-on-quarter to 477,000 tonnes in the September quarter 2021, but were up 4% year-on-year (65% year-on-year in value terms). Australia's concentrate exports to China increased by 0.6% quarter-on-quarter and were up 7.2% year-on-year, as trade stabilised after the normalising of concentrate imports from Peru to China in the prior quarter.

Australia's exports of refined zinc declined by 43% year-on-year and by 19% quarter-on-quarter to 58,200 tonnes in the September quarter 2021. Expansion of Sun Metals zinc refinery in Townsville is underway.

Australia's mine production is expected to increase

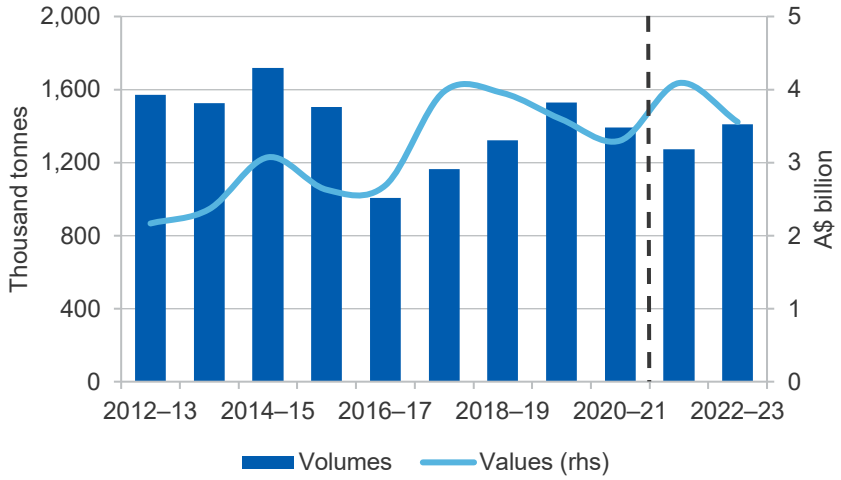
Australia's production is expected to continue growing over 2021–22, with stronger growth in 2022–23 (Figure 14.5). Australia's zinc mine output is expected to increase from 1.3 million tonnes in 2020–21 to 1.4 million tonnes in 2022–23. This rise will be driven by Century in Queensland with increasing contribution from Golden Grove in Western Australia, along with solid production from Mt Isa in Queensland and McArthur River in the Northern Territory.

Project development

New Century is examining a number of hard rock resources beyond the current tailings retreatment operation, which is due to end in 2027.

New Century believes hard rock resources have the potential to increase mine life to 2030 and are mostly contained on the existing mining lease. Century Zinc earlier reported positive results to their feasibility study of potential operations at Silver King and East Fault Block. The company is targeting a financial investment decision (FID) in the March quarter 2022 and possible first production in the March quarter 2023. They estimate additional zinc production of 22,000 tonnes a year.

Figure 14.5: Australia's zinc exports, metallic content



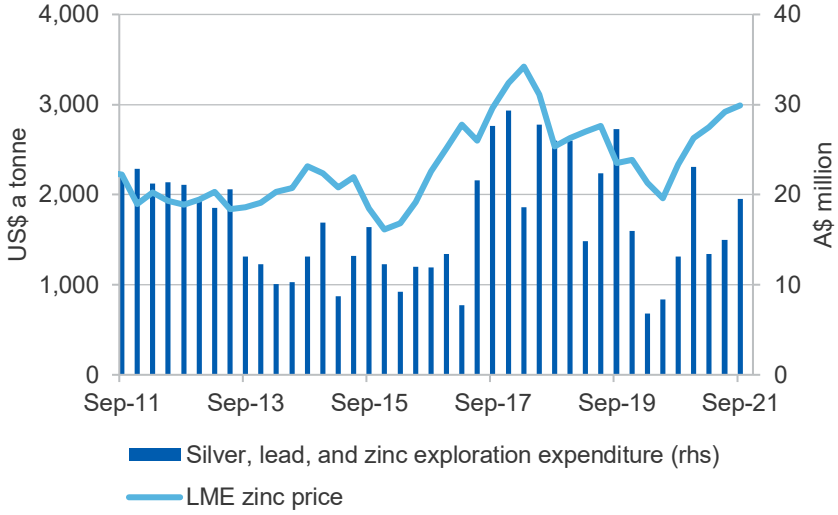
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Wood Mackenzie (2021); Department of Industry, Science, Energy and Resources (2021).

Galena Mining has commenced mining at Abra, with zinc production as a zinc-lead-silver concentrate expected by the company in 2023.

Exploration expenditure increased in the September quarter 2021

Exploration expenditure for silver, lead and zinc increased by 30% quarter-on-quarter for the September quarter 2021. Over the same period, the zinc price appreciated by 2.6% quarter-on-quarter (Figure 14.6). This increase in exploration is likely related to ongoing zinc price appreciation. When comparing year-on-year, exploration increased by 49% for the September quarter 2021, while the zinc price appreciated by 28% over the corresponding period, thus demonstrating the more traditional relationship between commodity prices and exploration. Promising drill results at Jaguar suggest potential for its life of mine to be extended.

Figure 14.6: Quarterly exploration expenditure



Source: ABS (2021) Mineral and Petroleum Exploration, Australia, 8412.0; Company reports; Department of Industry, Science, Energy and Resources (2021).

Revisions to the outlook

Compared with the September 2021 *Resources and Energy Quarterly*, forecasts for export revenue are up 0.3% at $4.1 billion in 2021–22, and down 8.4% to $3.6 billion in 2022–23.

Table 14.1: Zinc outlook

						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021[s]**	**2022[f]**	**2023[f]**
Production								
– mine	kt	12,238	12,994	13,108	13,246	6.2	0.9	1.0
– refined [a]	kt	13,690	13,970	14,221	14,366	2.0	1.8	1.0
Consumption	kt	13,212	14,062	14,266	14,404	6.4	1.5	1.0
Closing stocks	kt	975	1,020	1,059	1,087	4.6	3.7	2.7
– weeks of consumption		3.8	3.8	3.9	3.9	-1.7	2.3	1.8
Price								
– nominal	US$/t	2,263	3,013	2,991	2,675	33	-0.7	-10.6
	USc/lb	103	137	136	121	33	-0.7	-10.6
– real [b]	US$/t	2,346	3,013	2,891	2,518	28	-4.0	-12.9
	USc/lb	106	137	131	114	28	-4.0	-12.9
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Mine output	kt	1,345	1,335	1,360	1,450	-0.8	1.9	6.6
Refined output	kt	418	461	493	505	10.3	7.0	2.5
Export volume								
– ore and concentrate [c]	kt	2,556	2,118	2,027	2,225	-17.1	-4.3	9.7
– refined	kt	390	408	339	376	4.8	-17.0	10.5
– total metallic content	kt	1,530	1,392	1,273	1,409	-9.0	-8.6	9.8
Export value								
– nominal	A$m	3,592	3,301	4,089	3,555	-8.1	24	-13.0
– real [d]	A$m	3,739	3,381	4,089	3,480	-9.6	21	-14.9

Notes: **a** Includes secondary refined zinc; **b** In 2021 US dollars; **c** Quantities refer to the gross weight of all ores and concentrates; **d** In 2021–22 Australian dollars; **f** Forecast; **s** Estimate.

Source: ABS (2021) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Company reports; Department of Industry, Science, Energy and Resources (2021); International Lead Zinc Study Group (2021); Wood Mackenzie (2021); LME (2021).

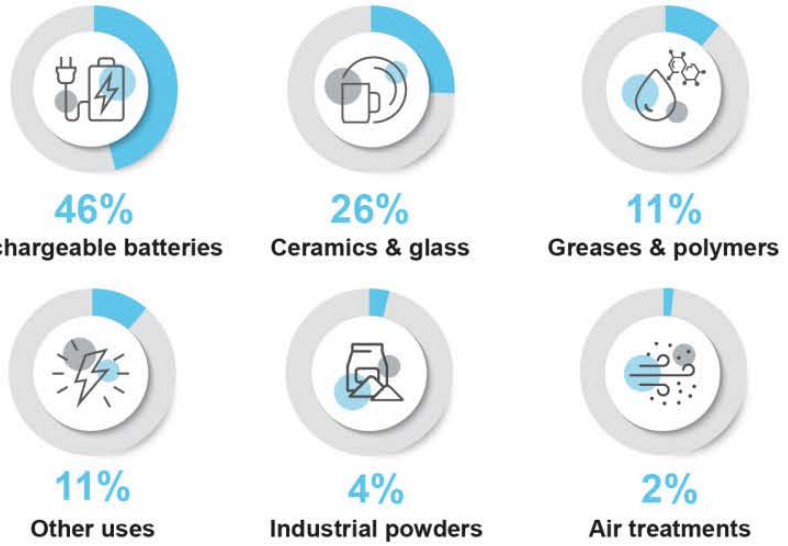
3 Li 6.94 Lithium

Major Australian Lithium deposits

Lithium facts

- **Electric vehicle sales** are expected to increase from **3m to 30m** by 2030
- **Lithium exports** contributed **A$1.1b** to economy in 2020-21
- Australian lithium exports are tipped to increase to **3.9m tonnes** in 2025-26
- In August 2021 Australia began **producing lithium hydroxide**

World consumption



Australia's lithium

- **Biggest exporter** in the world
- Produced **49%** of the **world's lithium** in 2020
- **Production ramp up** planned for 2 refineries in 2022/23

15.1 Summary

- Spodumene prices are forecast to rise to an average US$1,185 a tonne in 2022 from an estimated US$720 a tonne in 2021, but fall back to US$990 a tonne in 2023.
- Lithium hydroxide prices are forecast to rise from US$7,300 a tonne in 2020 to US$18,940 a tonne in 2023.
- Australia's lithium production is forecast to rise from 217,000 tonnes of lithium carbonate equivalent (LCE) in 2020–21 to 373,000 tonnes of LCE in 2022–23 (see *Australia section*).
- Australia's lithium export earnings are forecast to rise from $1.1 billion in 2020–21 to $4.2 billion in 2022–23 as lithium hydroxide production rises. First lithium hydroxide output occurred in August 2021.

15.2 World consumption

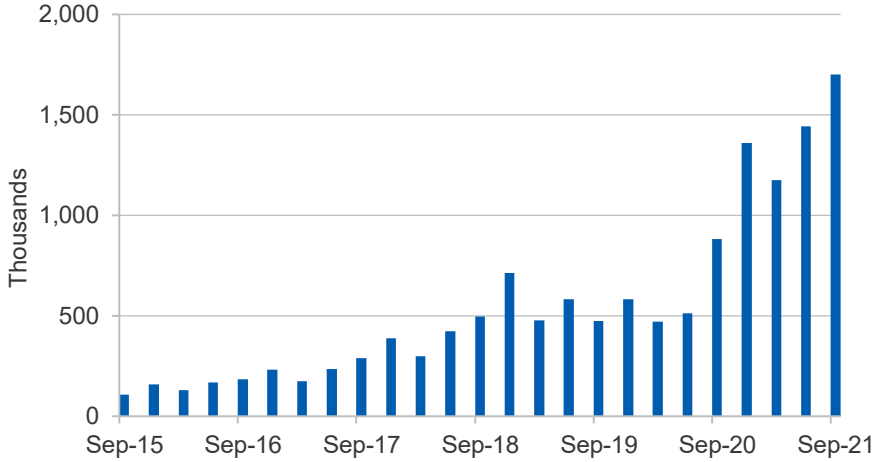
Increase in September quarter 2021 electric vehicle sales

Global electric vehicle (EV) sales rose by 18% quarter-on-quarter in the September quarter 2021 to be 93% higher than a year before (Figure 15.1). Global EV sales in 2021 are likely to exceed 5 million units. Sales were dominated by China and Europe.

The forecast for lithium demand is subject to greater than usual uncertainty, due to a semi-conductor shortage affecting the auto industry — which has led to a number of EV makers pushing delivery timeframes for various models out to 2023. Tesla and Volkswagen have publicly announced that they are experiencing supply chain issues. Market commentators such as Bloomberg New Energy Finance have internal combustion engine vehicles been projected to reach cost parity with EVs in 2023 in large markets, but supply chain issues may strain this timeline.

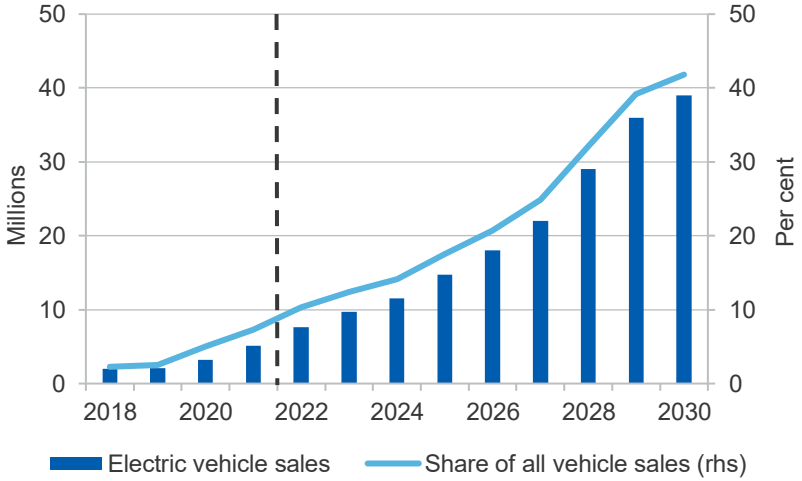
Bloomberg New Energy Finance and the International Energy Agency have EV demand projected to rise to about 30% of vehicle sales annually by 2030, given manufacturers' declarations of capacity hikes and recent strong sales trends (Figure 15.2).

Figure 15.1: World quarterly electric vehicle sales



Source: Source: Department of Industry, Science, Energy and Resources (2021); BloombergNEF (2021).

Figure 15.2: Long term sales projections



Source: Source: Department of Industry, Science, Energy and Resources (2021); BloombergNEF (2021).

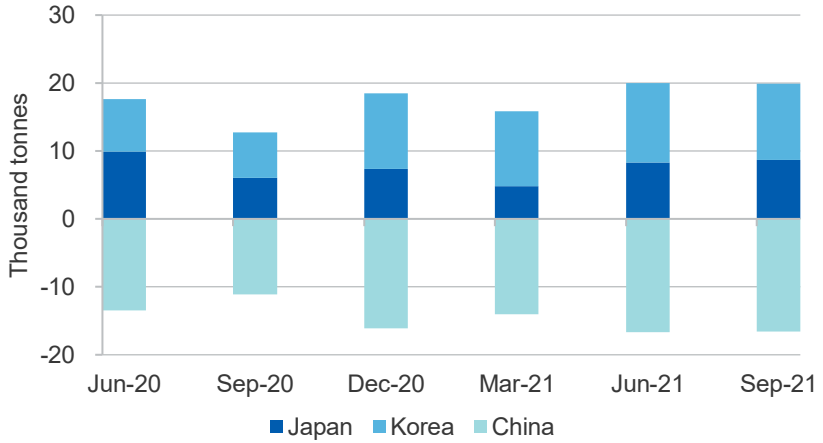
Lithium trade decreased due to a supply shortage

Over the September quarter 2021, China's lithium hydroxide exports decreased by 0.5% quarter-on-quarter, while its imports increased by 26% quarter-on-quarter as it struggled to maintained sufficient supply.

China's net imports of lithium carbonate fell by 34% from the June quarter, as supply became difficult to source. South Korean lithium hydroxide imports fell by 4.6% in the September quarter 2021, while imports of lithium carbonate fell by 23% quarter-on-quarter, as supply was difficult to obtain. Japan's lithium hydroxide imports rose by 5.2% quarter-on-quarter in the September quarter 2021, while carbonate imports rose by 9.9% quarter-on-quarter, with Japan able to obtain supply. Trade in lithium hydroxide between these nations tends to mirror Chinese refining patterns.

Lithium carbonate imports decreased overall (Figures 15.3 and 15.4), but Australia's growing exports of spodumene made up for some of the shortfall (Figure 15.5). Australian spodumene is processed into lithium hydroxide in China, but some domestic capacity for this is being built up.

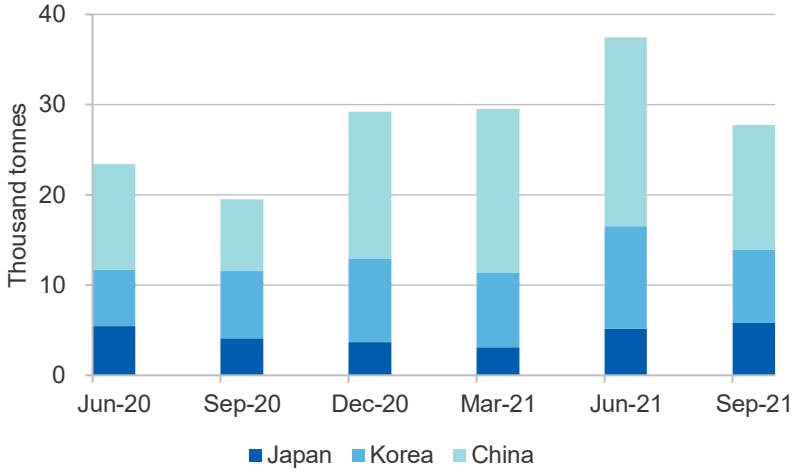
Figure 15.3: Lithium hydroxide imports and exports



Notes: Positive numbers = imports, negative numbers = exports.

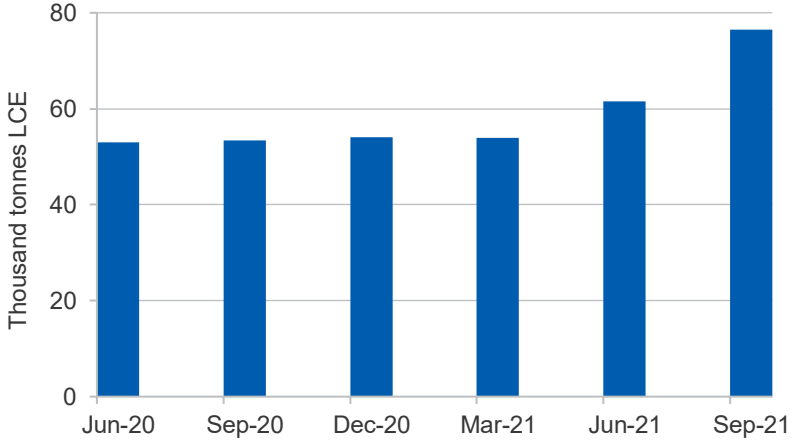
Source: BloombergNEF (2021); Department of Industry, Science, Energy and Resources (2021).

Figure 15.4: Lithium carbonate imports



Source: BloombergNEF (2021); Department of Industry, Science, Energy and Resources (2021).

Figure 15.5: Australian spodumene sales



Notes: ABS started collecting spodumene data as of 1 July 2021. Units in terms of lithium carbonate equivalent (LCE).

Source: Company reports; Department of Industry, Science, Energy and Resources (2021).

Lithium demand increasing strongly

World demand for lithium is estimated to increase to 486,000 tonnes of lithium carbonate equivalent (LCE) in 2021, from 305,000 tonnes in 2020 (Table 15.3). Demand is then forecast to reach 724,000 tonnes by 2023, as global EV uptake rises.

Increasing EV uptake is being driven by government measures, lower vehicle prices, and increasing model choice. Currently, there is a shortage of spodumene and lithium carbonate. Project development is underway — as well as increasing interest in recycling — that will aid in meeting the supply shortfall. The shortfall may continue beyond the outlook period.

Asia is still dominating lithium product demand, despite battery factories diversifying into Europe and the United States (Figures 15.3 and 15.4).

15.3 World production

Security of supply a priority as world demand lifts

Output is estimated at 485,000 tonnes LCE in 2021, and is forecast to increase to 615,000 tonnes in 2022 and 821,000 tonnes in 2023. At this stage, supply from mine and brine operations is falling short of matching demand growth. Project development is underway, but will take time to fill the supply gap.

The Americas

Chile is offering 400,000 tonnes of LCE for extraction, with five quotas of 80,000 tonnes each, with development over 7 years and production of 20 years. This is potentially a large increase in supply, but is one which will take significant time to come online. Bids for the quotas close in December 2021. Chile's Sociedad Quimica y Minera de Chile (SQM) and Albemarle are currently the only licenced lithium carbonate producers in Chile.

Chile's SQM is continuing its development path towards 180,000 tonnes a year of lithium carbonate, as well as 30,000 tonnes a year of lithium hydroxide. These levels are expected to be reached by end of 2022.

Albemarle's La Negra III and IV expansion projects in Chile are due to complete their ramp up by the end of 2022, with the operation set to be capable of producing 40,000 tonnes a year of lithium carbonate.

Galaxy Resources and Orocobre have finalised merger arrangements, with the new entity to be known as Orocobre. Its key development sites are for lithium carbonate production in Argentina. Orocobre's Sal de Vida project in Argentina is planned for possible production in 2022. The company expects final approvals by year end.

Production from the Olaroz operation in Argentina was 2,800 tonnes of lithium carbonate in the September quarter 2021 — down from 3,300 tonnes in the June quarter 2021. Expansion plans are underway to enable the production of 22,000 tonnes in 2022. Feasibility studies on James Bay in Canada are nearing completion for production of a spodumene concentrate.

Livent's expansion activities in Argentina remain on track to meet target dates for production increases — from 20,000 to 40,000 tonnes LCE — by the end of 2024. Additionally, the company is aiming to increase annual lithium hydroxide production in the US from 25,000 tonnes to 30,000 tonnes by late 2022.

Africa

AVZ Minerals announced an increase in lithium oxide reserves of the Manono deposit in the Democratic Republic of Congo, from 1.47 million tonnes to 2.14 million tonnes. Capital raising has been undertaken and financing discussions are advancing. A mining licence application has been lodged.

Asia

Orocobre is nearing the completion of construction for its Naraha plant in Japan to convert lithium carbonate into lithium hydroxide, based on feedstock of 10,000 tonnes a year of lithium carbonate from Argentina. Pre-commissioning work is underway, according to Orocobre.

15.4 Prices

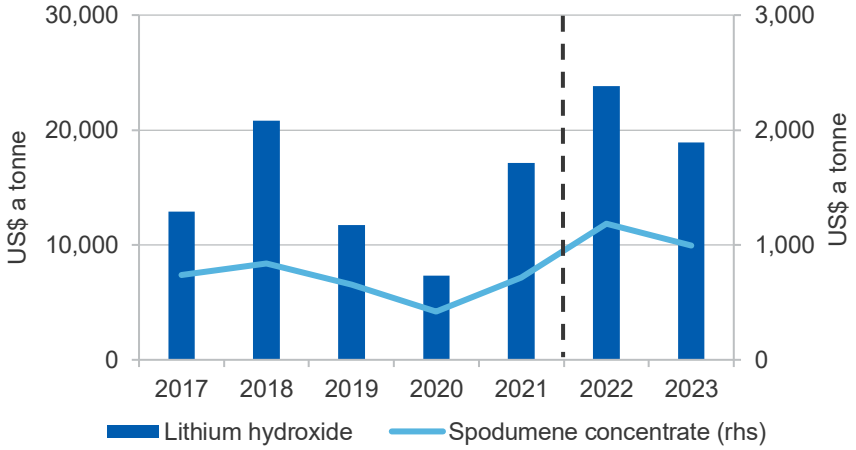
Lithium market: spot prices soar and contracts are negotiated

In the ten months to end October 2021, the spot lithium hydroxide price (delivered to China) averaged US$14,917 a tonne — double what was achieved in the full year 2020.

However, in early November 2021, LME cash-settled lithium hydroxide futures closed at US$29.00 a kilogram (or US$29,000 a tonne) via price assessment from Fast Markets. This is 61% higher than the price for the September quarter 2021, which averaged US$18,008 a tonne. The futures market lacks depth at present. As the market matures, lithium hydroxide futures contracts will assist in liquidity and transparency.

Lithium hydroxide prices are forecast to rise from US$7,300 a tonne in 2020 to US$18,940 a tonne in 2023. The drive upward in prices reflects forecast increased demand for the chemical from EV makers for cars with a longer driving range. High prices are also due to an inability to bring on more hydroxide refining capacity in a timely and cost effective manner.

Figure 15.6: Spodumene concentrate/lithium hydroxide prices



Notes: Lithium hydroxide price is for higher priced battery grade product.

Source: Roskill (2021); Department of Industry, Science, Energy and Resources (2021).

Spot spodumene prices (delivered to China) rose to US$2,240 a tonne in September 2021, up over five-fold since the start of the year. Spodumene prices are forecast to rise from an average of US$420 a tonne in 2020 to US$1,185 a tonne in 2022 and US$992 a tonne in 2023, with spot and contract pricing under negotiation.

Some Australian spodumene suppliers have historically worked off long term contracts. Pilbara Minerals' Battery Metals Exchange trading platform — intended to be used for uncontracted spodumene concentrate — commenced in July, with the initial parcel clearing at US$1,250 a tonne. However, at their late-October auction, they achieved US$2,350 a tonne on small volumes. Contract prices for spodumene are expected to increase strongly in 2022, driven both by rising EV production as well as short term supply issues (Figure 15.7).

15.5 Australia

Export values forecast to increase

A strong rise in the spodumene price is forecast to see export revenue increase from $1.1 billion in 2020–21 to $3.3 billion in 2021–22, with production from lithium hydroxide refineries forecast to add to earnings for a total export revenue of $4.2 billion by 2022–23 (Figure 15.7).

Australian production forecast to rise over the outlook period

Australian production is now expected to rise over the outlook period, from 217,000 tonnes of LCE in 2020–21 to 328,000 tonnes of LCE in 2021–22 and 373,000 tonnes of LCE in 2022–23. Correspondingly, spodumene concentrate exports are forecast to increase from 1.7 million tonnes in 2020–21 to 2.5 million tonnes in 2022–23 (Figure 15.7).

Price appreciation induced production increases

Australian spodumene concentrate output in the September quarter 2021 rose by 35% quarter-on-quarter (39% year-on-year) to 79,000 tonnes of LCE. Output is rising in response to surging spot prices.

Contract prices can be expected to rise in the wake of the spot prices, which should boost production at operations using long-term contracts.

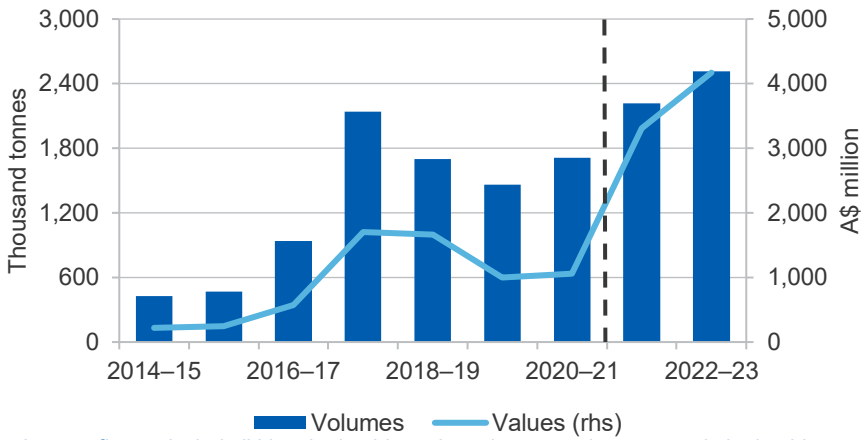
Pilbara Minerals production increased by 11% in the September quarter 2021 to 85,800 tonnes of spodumene concentrate. The Ngungaji plant (the old Altura plant) has now restarted, while the Pilgan plant has undergone modifications designed to debottleneck and enhance production. According to the company, a financial investment decision (FID) on the Phase 1 expansion of the Pilgan plant — for an incremental 100,000 tonnes a year of spodumene concentrate — may take place in early 2022.

A date has not yet been foreshadowed for the Phase 2 expansion, which would boost production by 320,000 tonnes a year. Production at the combined site is due to ramp up from around 380,000 tonnes a year to around 580,000 tonnes a year by mid-2022, before the Phase 1 and 2 expansions. The incremental production, to be processed through the Ngungaji plant, is not yet committed in contract. Pilbara Minerals stated that ore reserves on Pilgangoora increased by 54%, due to the discovery of new pegmatite domains as well as the tonnages acquired as a part of the Altura transaction.

Production from Mt Marion (owned 50% by Mineral Resources and 50% by Gangfeng Lithium Co. Limited) totalled 100,000 tonnes of spodumene concentrate in the September quarter 2021. Production at Orocobre's Mt Cattlin mine increased by 7.3% quarter-on-quarter to 68,000 tonnes of spodumene concentrate. The price achieved was US$779 a tonne, with contract pricing for next year under negotiation.

The Greenbushes mine — operated by the Talison Joint Venture — had estimated production of 40,000 tonnes of LCE in the September quarter 2021. Greenbushes commissioned their second chemical plant (CGP2) to produce 160,000 tonnes a year of LCE in total (i.e. approximately 1 million tonnes a year of spodumene concentrate) with the contract for design and engineering the third chemical grade plant (CGP3) awarded to Lycopodium.

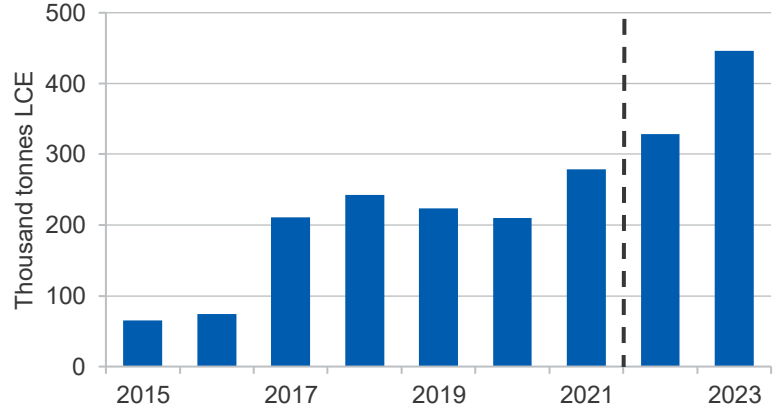
Figure 15.7: Australia's exports of spodumene concentrate



Notes: Income figures include lithium hydroxide and spodumene volumes contain hydroxide.

Source: Company reports; Roskill (2021); Department of Industry, Science, Energy and Resources (2021).

Figure 15.8: Australia's spodumene concentrate production



Notes: Lithium hydroxide is not included.

Source: Company reports; Roskill (2021); Department of Industry, Science, Energy and Resources (2021).

The sell-down by Tianqi to ASX-listed Independence Group included a 49% interest in the Kwinana lithium refinery. The Kwinana refinery processed its first lithium hydroxide in October, and is ramping up production to capacity of circa 24,000 tonnes a year.

Lithium hydroxide produced in Australia, Korea and Japan

Production commenced at Train I of Tianqi's Kwinana lithium hydroxide refinery (51% Tianqi and 49% ASX-listed Independence Group). Battery grade product is expected in the March quarter 2022, with ramp up to 24,000 tonnes a year by the end of 2022. Train 2 — 24,000 tonnes a year as well — is currently due to start production in 2024.

Finalisation of construction is underway at Kemerton's Stage I for 25,000 tonnes a year of lithium hydroxide (60% US-based Albemarle and 40% ASX-listed Mineral Resources). Kemerton's Stage II — for an additional 25,000 tonnes a year — has been delayed due to COVID-19 restrictions, with completion and ramp up of both stages to name-plate capacity expected late in 2022–23. Albemarle plans for Kemerton to initially source spodumene concentrate from Greenbushes. By 2023, Australia may have around 9% of global lithium hydroxide refining capacity and potentially reach 19% of global lithium refining by 2026 (Figure 15.9).

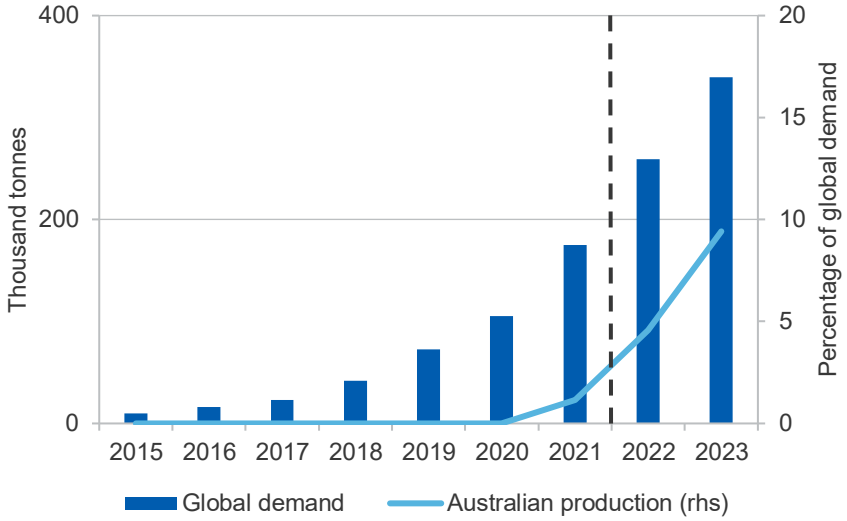
ASX-listed Pilbara Minerals have finalised their joint venture agreement with POSCO for the production of 43,000 tonnes a year of refined lithium hydroxide to be produced in South Korea. The joint venture plans to source 315,000 tonnes a year of spodumene concentrate from the Pilgangoora operations, based on existing production capacity.

Construction of the Kwinana lithium hydroxide refinery (50% ASX-listed Wesfarmers and 50% Chile-based SQM) continues. The refinery will source spodumene from the Mt Holland deposit. According to the joint venture partners, the refinery is expected to begin operating in 2024. Mt Holland is initially expected to produce 400,000 tonnes a year of spodumene concentrate.

ASX-listed Orocobre is in the process of completing construction of their Naraha plant in Japan. The company plans to convert lithium carbonate into lithium hydroxide using feedstock from their operations in Argentina. Pre-commissioning works are underway, according to the company.

The branching out of Australian companies into Japan and Korea for the production of lithium hydroxide, as well as production in Australia, shows Australian companies are eager to grasp the available opportunities from the current shift in the market towards low emissions technologies.

Figure 15.9: World and Australian lithium hydroxide output



Source: BloombergNEF (2021); Department of Industry, Science, Energy and Resources (2021).

Project development in Australia

Greenbushes' chemical grade plant (CGP2) has been commissioned, with CGP3 committed. The Wodgina mine (60% Albemarle and 40% Mineral Resources) is to recommence production from one of its three spodumene production facilities, at 250,000 tonnes a year of spodumene concentrate.

A detailed feasibility study on Liontown's Kathleen Valley deposit near Kalgoorlie is due for completion in late 2021, with the company suggesting production in 2024 at 50,000 tonnes a year (LCE). The company is working on compressing its development timetable. The deposit is similar to that of Mt Holland.

Core Lithium have made an FID on the development of its Finniss deposit near Darwin. A scoping study is underway on extending the mine life, as well as creating a fine grained lithium product from the tailings, in order to maximise revenue from the project. The company has stated that it plans to start production in 2022. Recent equity raising and offtake agreements have the project fully funded to commence construction. Production could commence from late 2022 to early 2023. Investigations are also underway on the potential for an associated lithium hydroxide refinery. Gangfeng and Yahua have offtake agreements for 80% of the first 4 years of production.

Value-adding in Australia

Australian companies are branching out along the battery value chain from mining and refining, into precursor chemicals for cathodes, battery anode plants, electrolyte production, battery cell research/production, and battery manufacturing. There is also production of electric trucks for underground mine use. The supply chain is not fully integrated as yet, but clearly demonstrates Australian companies' willingness to engage in the opportunities at hand (Tables 15.1 and 15.2, Figure 15.10).

Revisions to the outlook

Forecast exports in 2021–22 have been revised slightly — from $3.4 billion to $3.3 billion — allowing for the timing of contract roll-over with higher prices. Export earnings in 2022–23 have been revised up from $3.8 billion to $4.2 billion (up 8.8%), again reflecting the very strong gains in the spodumene price to roll through on the contract pricing front.

Box 15.1: Lithium value-adding in Australia - Li-S Energy ASX Debut

Li-S Energy made its debut on the ASX in late September 2021. The company is developing lithium sulphur batteries. These type of batteries have an energy density around five times higher than normal lithium-ion batteries. These batteries have suffered from 'degradation' in the past, which has made them impractical for commercial applications. However, Li-S Energy appears to have solved the degradation issues using boron nitrate nanotubes. According to the company, their battery technology allows for around 1,000 cycles of discharge/recharge — similar to commercial lithium-ion batteries — but has higher energy density, which may lead to a longer driving distance.

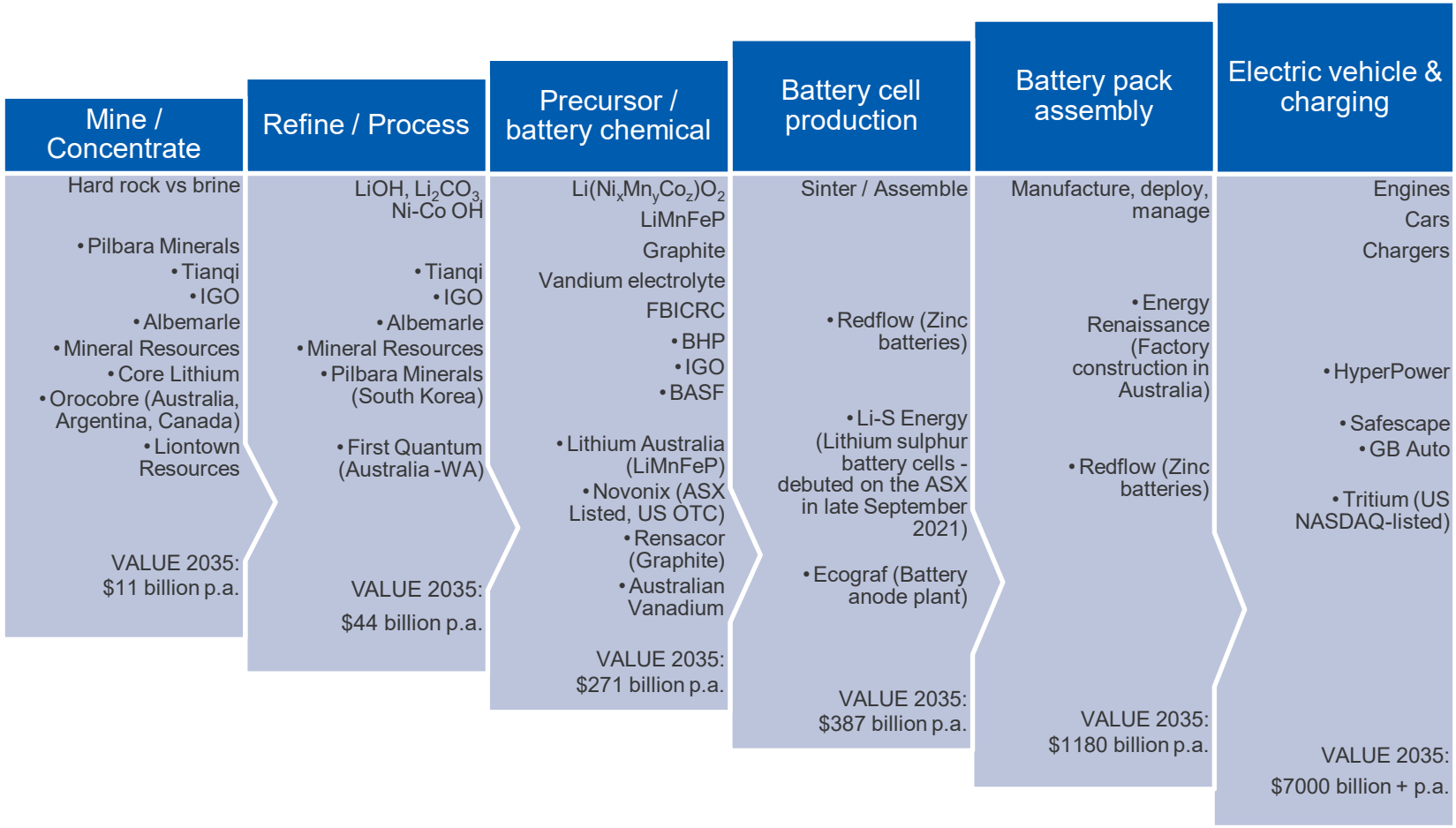
The company has been conducting its research in conjunction with Deakin University in Geelong and is being assisted towards commercialisation by PPK Group Limited — a Queensland based company — which specialises in battery and mining technology.

They have also developed a nano-mesh to fix the 'dendrite' problem in batteries — a problem which affects numerous battery types, leading to fires when the dendrites pierce the cell membranes. Single layer cells have been tested, and multilayer cell testing is underway, with a pilot plant in the planning stage.

Li-S Energy has entered into a collaborative agreement with Janus Electric (Janus). Janus have developed a proprietary system for converting diesel prime movers to battery powered via battery change over, multiparty battery ownership, charging network and custom software. Subject to further agreement Janus may acquire almost 500,000 battery cells by 2023.

Source: Company reports (2021); https://www.aumanufacturing.com.au/li-s-energy-to-supply-novel-batteries-for-janus-electric-trucks (2021); https://www.abc.net.au/radio/brisbane/programs/drive/energy-asx/13561938 (2021)

Figure 15.10: Projected global value of lithium-ion battery value chain (+ zinc and vanadium batteries for large scale storage)



Notes: . Redflow is ASX listed and is currently producing zinc batteries offshore. Zinc and vanadium batteries are suitable for large scale storage.

Source: BloombergNEF (2021), *Australasian Institute of Mining and Metallurgy: Thought leadership conference*, September 2021; Future Battery Industry Co-operative Research Centre (2021).

Table 15.1: Australian companies: value-adding lithium (chemical refining and batteries)

Company Name	Main Exchange	Country of development opportunity	Commentary
Chemical refining and new 'brands' of lithium			
Mineral Resources	ASX	Australia	Albemarle is in the process of commissioning/completing construction of the Kemerton lithium refinery. Mineral Resources Limited has a 40% share in the operation. Construction is due for completion in 2022 / 2023.
Independence Group	ASX	Australia	Independence Group has purchased a 24.99% share in Greenbushes and a 49% share in its associated Kwinana lithium refinery. The Kwinana lithium refinery started producing lithium hydroxide in August 2021.
Wesfarmers	ASX	Australia	Mt Holland and its associated Kwinana–Covalent lithium refinery for lithium hydroxide production in Australia in conjunction with partner, SQM. Production may commence in 2024.
Pilbara Metals	ASX	Korea	Pilbara Minerals has entered a joint venture with POSCO to refine 43,000 tonnes a year of lithium hydroxide, to be produced in South Korea.
Lake Resources	ASX	Argentina	Feasibility studies are ongoing for the Kachi deposit, and finance is well advanced for development.
Battery components & battery manufacture			
Novonix	ASX	United States	Novonix is developing its anode graphite technology in the US. Phillips 66 (A spin-off of Conoco Phillips) has taken a strategic stake in the company.
Energy Renaissance	Private	Australia	Construction has commenced on a lithium battery production facility just outside of Newcastle – due for completion in 2021. The factory is designed to produce lithium batteries for hot Australian conditions.
Li-S Energy	ASX	Australia	Li-S Energy debuted on the ASX in late September 2021. It focuses on the commercialisation of lithium sulphur batteries with very high energy densities via boron nitrate nano-tubes, as well as solving battery issues such as fire caused by dendrites penetrating cell membranes using nano-mesh. It is currently planning a pilot plant to further test these developments. It has a collaborative agreement with Janus Electric, who specialise in converting prime movers from diesel to battery power.

Source: Company reports (2021).

Table 15.2: Australian companies: value-adding lithium (recycling, research and manufacturing)

Company Name	Main Exchange	Country of development opportunity	Commentary
Lithium batteries and recycling			
Lithium Australia	ASX	Global	The company is developing lithium recycling and examining lithium iron phosphate (LFP) battery manufacturing with the addition of manganese to improve battery performance. A patent application for the manufacture of LFP cathode powder has been accepted. An application has been lodged for a grant under the Modern Manufacturing Initiative.
Neometals	ASX	Germany and India	A shredding demonstration plant has been successfully commissioned. A demonstration hydrometallurgy plant is in the process of commissioning. Scale up options are being examined due to high demand.
Electric vehicles, charging infrastructure			
Tritium	Private	Global	Tritium became the first company in the world to implement ISO15118, allowing electric cars and charging equipment to communicate and transact seamlessly via the charging cable. Tritium is now NASDAQ-listed.
GB Auto	Private	Australia	Conversion kits for mine trucks are to become electric, including Toyota Land Cruisers and Toyota Hilux trucks.
HyperPower	Private	Global	The company is working on production of motors for electric transport, via vehicle or rail, capable of speeds of over 600 kilometres per hour. It is scaling up production and iterative engineering to evaluate industrial and commercial end-uses. They are also assessing mining applications.
Safescape	Private	Australia	The company is developing mine-specification heavy duty 4WDs through its Bortana EV range. Independence Group has successfully trialled the vehicles in its underground Nova nickel operation.
Battery industries research and development			
Future Batteries Industry CRC	Government	Global	The Future Batteries Industry CRC is Australia's largest battery industry R&D collaboration, which aims to help leverage Australia's traditional competitive advantages downstream in the global battery value chain and support the development of new battery storage systems. The German company, BASF, is now part of the sponsorship of the cathode precursor pilot plant. Trials are scheduled out to 2024 with continuous manufacture, similar in style to that being undertaken by BASF in Europe.

Source: Company reports and websites (2021).

Table 15.3: Lithium Outlook

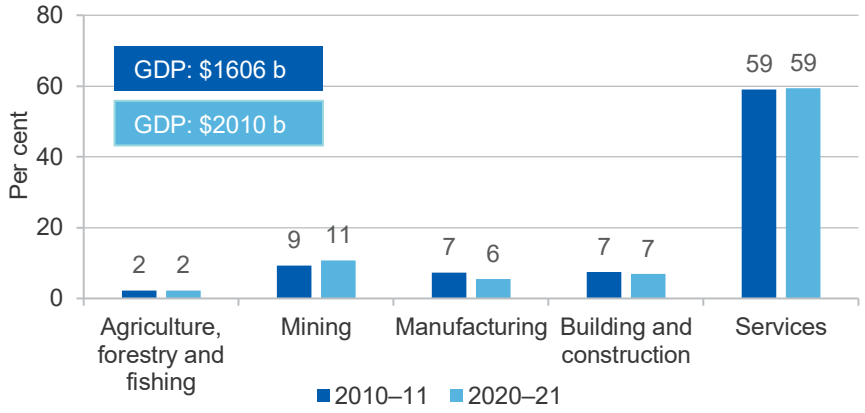
						Annual percentage change		
World	**Unit**	**2020**	**2021[s]**	**2022[f]**	**2023[f]**	**2021[s]**	**2022[f]**	**2023[f]**
Lithium production [a]	kt	464	485	615	821	4.7	27	33
Demand [b]	kt	305	486	573	724	60	17.8	26
Stocks [c]	kt	122	114	124	175	-6.3	9.3	41
– weeks of consumption		20.7	12.2	11.3	12.6	-41	-7.2	11.2
Spodumene price								
– nominal	US$/t	420	719	1,185	992	71	65	-16.2
– real [d]	US$/t	435	719	1,145	934	65	59	-18.4
Lithium hydroxide price								
– nominal	US$/t	7,303	17,137	23,804	18,943	135	39	-20
– real [d]	US$/t	7,571	17,137	23,009	17,835	126	34	-22
Australia	**Unit**	**2019–20**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2020–21**	**2021–22[f]**	**2022–23[f]**
Mine production [a]	kt	216	217	328	373	0.4	51	13.5
Spodumene export volume [e]	kt	1,460	1,714	2,215	2,515	17.4	29	13.5
Export value								
– nominal value [g]	A$m	999	1,054	3,308	4,170	5.6	213	26
– real value [h]	A$m	1,039	1,080	3,308	4,082	3.9	206	23

Notes: **a** Lithium Carbonate Equivalent — a measure of the quantity of refined product; **b** Demand is ahead of consumption by approximately 12 months due to the lead time required in battery manufacturing; **c** Stockpile estimates — difficult to estimate, calculated after losses from refining, and allowing for lead time in battery manufacturing; **d** In 2021 US dollars; **e** Spodumene concentrates — mostly 6 per cent Li_2O concentrate. Stockpiles run down in 2019–20; **f** Forecast; **g** Revenue from spodumene concentrate as well as lithium hydroxide; **h** In 2021–22 Australian dollars; **s** Estimate.

Source: Company reports; Department of Industry, Science, Energy and Resources (2021); Roskill (2021); BloombergNEF (2021); Government of Western Australia Department of Mines, Industry Regulation and Safety (2021).

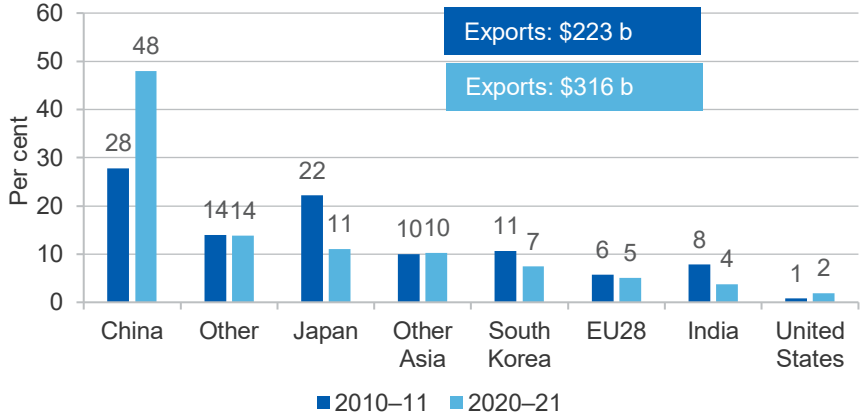
Trade summary charts and tables

Figure 16.1: Industry shares of GDP



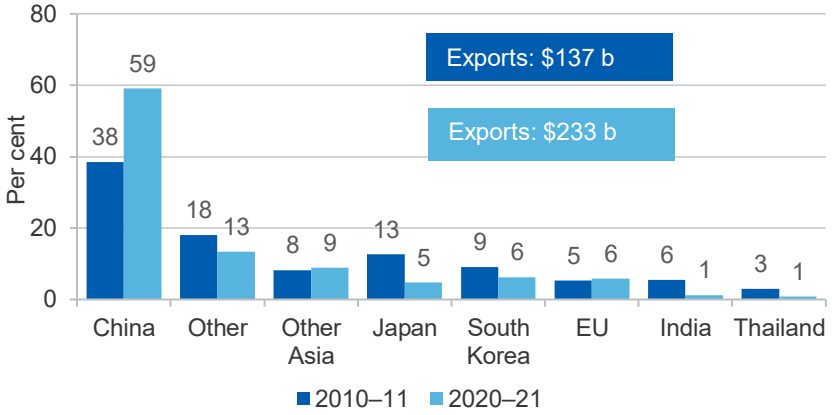
Source: ABS (2021) Australian National Accounts, National Income, Expenditure & Production, 5204.0

Figure 16.2: Principal markets for Australia's resources and energy exports, 2021–22 dollars



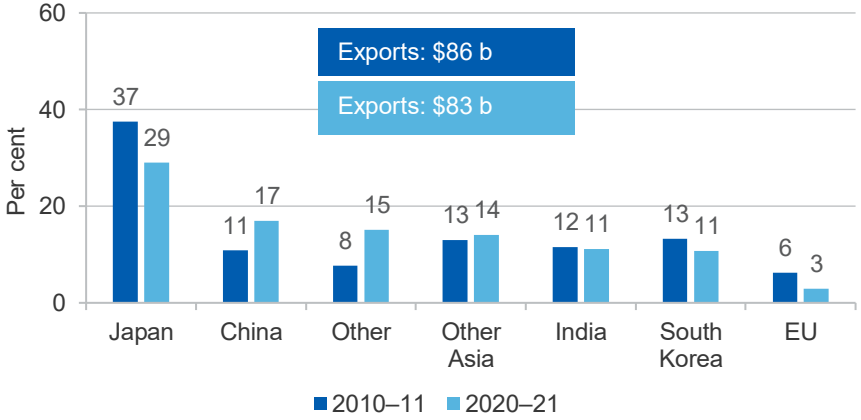
Source: ABS (2021) International Trade in Goods and Services, 5368.0

Figure 16.3: Principal markets for Australia's resources exports, 2021–22 dollars



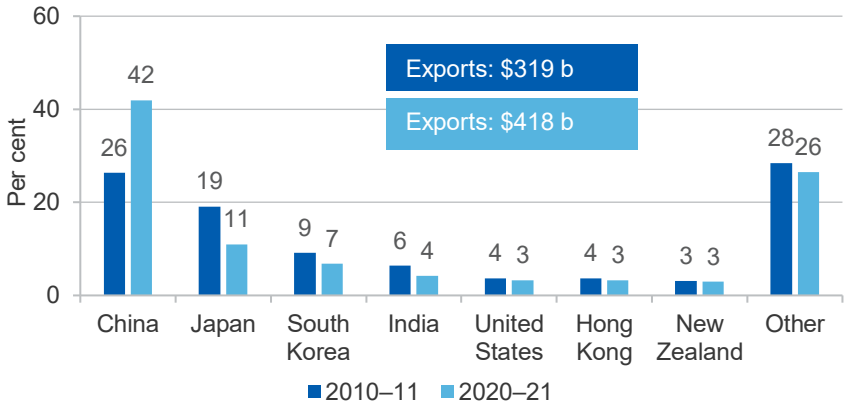
Source: ABS (2021) International Trade in Goods and Services, 5368.0

Figure 16.4: Principal markets for Australia's energy exports, 2021–22 dollars



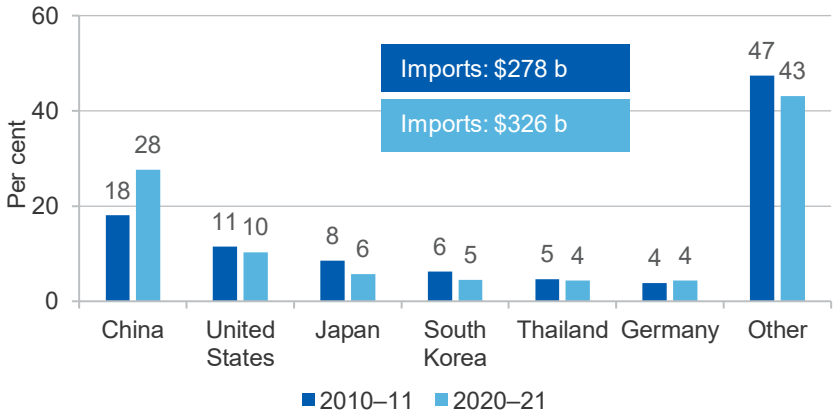
Source: ABS (2021) International Trade in Goods and Services, 5368.0

Figure 16.5: Principal markets for Australia's total exports, 2021–22 dollars



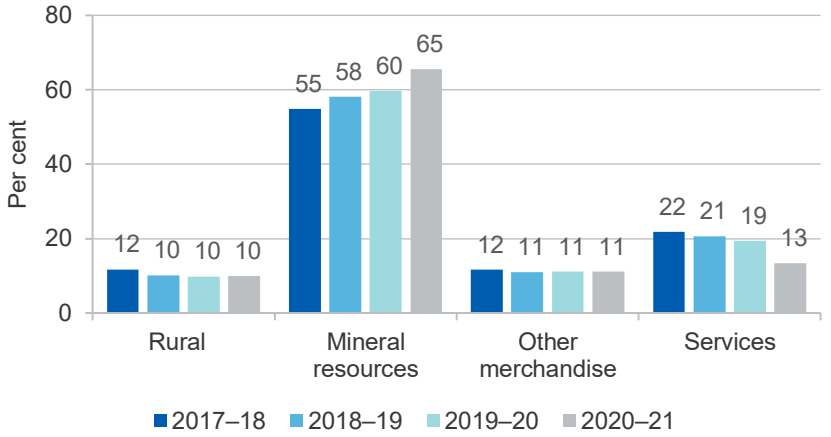
Source: ABS (2021) International Trade in Goods and Services, 5368.0

Figure 16.6: Australia's total imports by country of origin, 2021–22 dollars



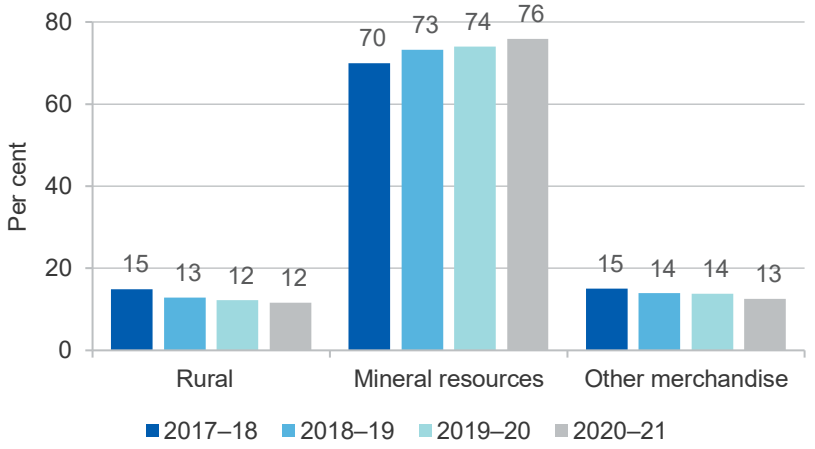
Source: ABS (2021) International Trade in Goods and Services, 5368.0

Figure 16.7: Proportion of goods and services exports by sector



Source: ABS (2021) Balance of Payments and International Investment Position, 5302.0

Figure 16.8: Proportion of merchandise exports by sector



Source: ABS (2021) Balance of Payments and International Investment Position, 5302.0

Table 16.1: Principal markets for Australia's thermal coal exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	8,952	10,492	12,203	8,643	7,131
South Korea	$m	2,787	3,169	4,000	2,944	2,617
Taiwan	$m	2,456	2,742	3,318	2,470	2,099
Vietnam	$m	159	136	697	1,078	725
Malaysia	$m	700	797	949	553	570
Thailand	$m	316	395	420	447	528
Total	**$m**	**20,656**	**24,215**	**27,379**	**21,207**	**16,385**

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Table 16.2: Principal markets for Australia's metallurgical coal exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
India	$m	9,098	10,114	11,796	7,755	7,723
Japan	$m	7,543	7,747	8,035	6,300	4,826
South Korea	$m	4,010	3,911	4,222	3,141	2,775
China	$m	8,320	8,934	10,377	10,123	1,700
Taiwan	$m	1,981	2,062	2,725	2,064	1,357
Netherlands	$m	2,051	1,911	1,880	1,285	902
Total	**$m**	**38,413**	**40,308**	**45,786**	**35,458**	**23,801**

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Table 16.3: Principal markets for Australia's crude oil and refinery feedstocks exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Singapore	$m	1,101	1,252	2,042	1,408	1,692
Malaysia	$m	464	625	1,721	1,049	670
Indonesia	$m	998	1,395	680	788	628
Thailand	$m	612	1,230	1,175	640	371
China	$m	769	672	1,058	1,069	164
Japan	$m	387	384	315	142	93
Total	**$m**	**5,953**	**7,421**	**9,518**	**9,328**	**7,575**

Note: Some country details have been confidentialised by the Australian Bureau of Statistics.

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Table 16.4: Principal markets for Australia's LNG exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	12,297	15,477	22,255	20,634	11,893
China	$m	6,201	10,197	18,343	16,853	11,601
South Korea	$m	2,778	3,933	5,568	5,344	3,414
Taiwan	$m	276	797	2,459	2,685	2,285
Singapore	$m	1,555	1,211	1,298	1,076	841
Malaysia	$m	227	388	915	1,507	508
Total	**$m**	**24,251**	**32,963**	**52,177**	**49,208**	**31,053**

Notes: Department of Industry, Science, Energy and Resources estimates based on International Trade Centre data, except for 2016–17 where ABS trade data is available.

Source: ABS (2021) International Trade in Goods and Services, 5368.0; International Trade Centre (2021) International Trade Statistics

Table 16.5: Principal markets for Australia's iron ore exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
China	$m	56,027	53,454	66,593	87,790	127,177
South Korea	$m	5,856	5,686	6,041	7,287	9,252
Japan	$m	4,248	3,846	4,897	6,442	9,204
Taiwan	$m	1,557	1,317	1,855	1,942	3,128
Indonesia	$m	47	47	46	28	41
India	$m	6	320	249	21	10
Total	**$m**	**68,428**	**65,819**	**81,798**	**107,061**	**156,675**

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Table 16.6: Principal markets for Australia's aluminium exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	1,014	1,465	1,385	1,052	974
South Korea	$m	805	900	805	1,179	923
Taiwan	$m	224	349	308	373	424
Thailand	$m	334	399	411	300	355
United States	$m	138	197	882	255	261
China	$m	55	36	18	30	120
Total	**$m**	**3,461**	**4,303**	**4,394**	**3,843**	**3,854**

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Table 16.7: Principal markets for Australia's copper exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
China	$m	2,933	4,018	3,784	3,921	2,799
South Korea	$m	485	310	717	674	1,346
Malaysia	$m	935	928	1,302	853	866
India	$m	742	893	466	479	639
Japan	$m	1,474	1,627	1,923	2,201	17
Philippines	$m	432	178	642	373	0
Total	**$m**	**8,271**	**9,060**	**10,304**	**10,625**	**11,723**

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Table 16.8: Principal markets for Australia's gold exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
United Kingdom	$m	4,254	3,486	4,530	13,157	9,102
United States	$m	160	79	133	3,188	4,012
Singapore	$m	332	1,234	1,668	1,473	2,988
China	$m	2,522	3,134	5,322	853	2,066
Switzerland	$m	1,030	1,167	1,218	1,966	1,924
India	$m	445	780	607	69	1,502
Total	**$m**	**20,740**	**20,684**	**19,900**	**25,390**	**26,737**

Source: ABS (2021) International Trade in Goods and Services, 5368.0

Appendices

Appendix A
Definitions and classifications

A.1 Exchange rates

In this report, the AUD/USD exchange rate (Australian dollar relative to the US dollars) is based on the median of economic forecasters at the time that the report is prepared. The source is the Bloomberg survey of economic forecasters.

World commodity prices are typically denominated in US dollars, and exchange rate movements can have a significant effect on the actual outcomes of commodity prices and export earnings. A change in the value of the US dollar against other floating international currencies can influence movements in world resources and energy prices. A change in the Australian dollar against the US dollar will impact on export earnings for domestic commodity exporters and producers. There is substantial uncertainty surrounding any exchange rate forecast, with changes to exchange rates influenced by changes in financial market sentiment, sometimes resulting in strong volatility.

A.2 Conversion to real dollars

Nominal values and prices are converted to real dollars using Australian and US consumer price indexes (CPI). The Australian and US CPI forecasts are based on the median of economic forecasters at the time that the report was prepared. The source is the Bloomberg survey of economic forecasters.

A.3 Time periods

The terms 'estimate', 'forecast' and 'projection' refer to different time periods in this report. Estimate refers to a time period that has passed, but for which full historical data is not yet available, while 'forecast' and 'projection' refer to different periods in the future. It is important to distinguish between different future time horizons, as factors affecting production, consumption and prices in the short-term differ from factors affecting these components in the medium to long-term. Forecasts also become increasingly imprecise over longer time horizons, due to increased risk and uncertainty. For these reasons, the Department of Industry, Science, Energy and Resources' Office of the Chief Economist (DISER OCE) uses different terminology to distinguish between short-term forecasts and medium to long-term projections, as outlined in *Table A2*.

Table A1: OCE terminology for different time periods/horizons

Period	Years	Terminology
Historical	Time period has passed but complete data for the period is not yet available	Estimate
Short-term	1 to 2 years	Forecast
Medium-term	3 to 5 years	Projection
Long-term	Beyond 5 years	n/a

Source: Department of Industry, Science, Energy and Resources (2021)

A.4 Commodity classifications

The DISER OCE defines exports for each commodity by a selected set of 8-digit Australian Harmonised Export Commodity Classification (AHECC) codes. Where possible, the choice of AHECC codes is based on alignment with international trade data, to ensure that direct comparisons can be made. For example, groupings for various commodities are aligned with classifications used by the International Energy Agency, World Steel Association, International Nickel Study Group, International Lead and Zinc Study Group, International Copper Study Group and World Bureau of Metal Statistics.

In this report, benchmark prices and Australian production and exports are forecast for 21 commodities, as shown in *Table A2*. In estimating a total for Australia's resources and energy exports, the remaining commodities, defined as 'other resources' and 'other energy', are forecast as a group.

Table A2: Resources and energy commodities groupings and definitions

	Resources (non-energy)	Energy
Definition	Resource commodities are non-energy minerals and semi-manufactured products produced from non-energy minerals	Energy commodities are minerals and petroleum products that are typically used for power generation
Australian Harmonised Export Commodity Classification (AHECC) chapters	25 (part); 26 (part); 28 (part); 31 (part); 73 (part); 74; 75; 76; 78; 79; 80; 81	27 (part)
Commodities for which data is published, forecasts are made and analysed in detail in this report	Aluminium; alumina; bauxite; copper; gold; iron ore; crude steel; nickel; zinc, lithium	Crude oil and petroleum products; LNG; metallurgical coal; thermal coal; uranium

Notes: The AHECC chapter is the first two digits of the trade code. Groupings are made at the 8-digit level.

Source: Department of Industry, Science, Energy and Resources (2021)

Appendix B Glossary

Term	Description
A$	Australian dollar
ABS	Australian Bureau of Statistics
AHECC	Australian Harmonized Export Commodity Classification
AISC	All-In Sustaining Cost — an extension of existing cash cost metrics and incorporates costs related to sustaining production.
Base metals	A common metal that is not considered precious (includes aluminium, copper, lead, nickel, tin, zinc)
Bbl	Barrel
Bcm	Billion cubic metres
Benchmark	A standard specification used to price commodities.
BF and BOF	Blast furnace and basic oxygen furnace — used in an integrated steelmaking process that uses iron ore and coal.
Bulks	Non-liquid and non-gaseous commodities shipped in mass and loose (iron ore, coal, bauxite)
CAGR	Compound annual growth rate
Capex	Capital expenditure
CFR	Cost and freight — Seller clears exports, and pays freight.
CIF	Cost, Insurance, and Freight
Coal Seam Gas (CSG)	Natural gas found in coal seams. Also known as Coal Bed Methane (CBM)
Coke	Made by heating coal at high temperatures without oxygen, and used to reduce iron ore to molten iron saturated with carbon, called hot metal

Conventional gas	Natural gas that can be produced from reservoirs using traditional techniques. Contrasts with unconventional gas.
COVID-19	2019 Novel Coronavirus
CPB	CPB Netherlands Bureau for Economic Policy Analysis
CPI	Consumer Price Index — measures quarterly changes in the price of a basket of goods and services which account for a high proportion of expenditure by the CPI population group (i.e. metropolitan households).
Crude steel	Steel in the first solid state after melting, suitable for further processing or for sale.
DES	Delivered Ex Ship — price of LNG including shipping and insurance.
DISER	Department of Industry, Science, Energy and Resources
DMO	Domestic Market Obligation — a policy to reserve energy commodities for domestic usage
DRC	Democratic Republic of the Congo
ECB	European Central Bank
Economic growth	An increase in the capacity of an economy to produce goods and services, compared from one period of time to another. It is measured in nominal or real gross domestic product (GDP).
EIA	The United States Energy Information Administration
EAF	Electric arc furnace — a furnace that melts steel scrap using the heat generated by a high power electric arc.
ETF	Exchange Traded Fund — an exchange traded fund that allows investors to invest in gold on the exchange.
EUV	Export unit value — export value/volumes exported
EV	Electric vehicle
f	Forecast — a two year outlook
FEED	Front end engineering design
FID	Final investment decision

FOB	Free on board — seller clears export, buyer pays freight.
GAD	Gross air dried basis — For measuring coal quality.
GAR	Gross as received basis — For measuring coal quality.
GBP	Great Britain Pounds
GDP	Gross Domestic Product — measures the value of economic activity within a country/group.
GFC	Global Financial Crisis — the period of extreme stress in global financial markets and banking systems between mid-2007 and early 2009.
GJ	Gigajoule
GST	Goods and Services Tax — a value-added tax levied on most goods and services sold for domestic consumption.
HCC	Hard coking coal — The best grade of metallurgical coal used in the steel production process. Australian hard coking coal is regarded as the industry benchmark.
IEA	International Energy Agency
IMF	International Monetary Fund — an international organisation that promotes international financial stability and monetary cooperation.
IMO	International Maritime Organisation
IP	Industrial Production — measures the output of the industrial sector that comprises mining, manufacturing, utilities and construction.
IPO	Initial public offering — a process of offering shares of a private corporation to the public in a new stock issuance.
ISM	US Institute for Supply Management
ISM	Institute of Supply Management
JCC	Japan Customs-cleared Crude (or Japan Crude Cocktail) — average price of crude oil imported by Japan and a common price index in long-term LNG contracts.
JFY	Japanese fiscal year
kcal/kg	Kilocalories per kilogram

kt	Thousand tonnes
ktpa	Kilotonnes per annum
LBMA	London Bullion Market Association
LCE	Lithium Content Equivalent
Li OH	Lithium Hydroxide
LME	London Metal Exchange
LNG	Liquefied natural gas
LNY	Lunar New Year
LPG	Liquefied petroleum gas
LVPCI	Low volatile pulverised coal injection — a type of low volatile coal used in the PCI process
m	Million
MMbtu	Million British thermal units
Mt	Million tonnes
mtpa	Million tonnes per annum
MW	Megawatts
Nameplate capacity	The theoretical maximum annual production capacity
NAR	Net as received basis — For measuring coal quality
NDRC	China’s National Development and Reform Commission
NEV	New energy vehicle — term used for plug-in electric vehicles eligible for public subsidies (battery electric vehicles and plug-in hybrid vehicles)

OCE	Office of the Chief Economist
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of Petroleum Exporting Countries, a formal alliance of 14 countries to collaborate to manage the world oil market
OPEC+	Informal term for agreements between OPEC and ten other oil-producing countries (which are not members of OPEC)
Oz	Ounce
PCE	Personal Consumption Expenditure — a measure of the changes in price of consumer services and goods.
PCI	Pulverised coal injection — PCI coal is used for its heat value and injected directly into blast furnaces as a supplementary fuel, which reduces the amount of coke required.
PCI	Pulverised coal injection — a process used in blast furnace operations
PM	The afternoon price of gold set at 3.00pm each business day at the London Bullion Market Association
PMI	Purchasing Managers Index — an indicator of economic health for manufacturing and service sectors.
PPP	Purchasing Power Parity — a way of measuring economic variables in different countries that equalise the purchasing power of different currencies
RoW	Rest of world
s	Estimate — Incomplete data or subject to revision
Shale gas	Natural gas found in shales
SDR	Special drawing right
SHFE	Shanghai Futures Exchange
SSCC	Semi-soft coking coal — A type of metallurgical coal used in the steel production process alongside hard coking coal, but results in a lower coke quality and more impurities.
Tariff	A tax on imports or exports that is used by governments to generate revenue or to protect domestic industries from competition.
Tight gas	Natural gas found in low quality reservoirs

TWI	Trade Weighted Index — a measure of the foreign exchange value of the US dollar against a basket of major foreign currencies.
U3O8	Triuranium octoxide — a compound of uranium.
UAE	United Arab Emirates
UK	United Kingdom
Unconventional gas	Natural gas that is more difficult to extract, including coal seam gas, shale gas and tight gas. Contrasts with conventional gas.
US	United States
US$	United States dollar
WEO	The International Energy Agency's World Energy Outlook
WTI	West Texas Intermediate crude oil price
z	Projection a five year outlook